# THROUGH THE AIR

John Wise

# THROUGH THE AIR:

A NARRATIVE OF

## FORTY YEARS' EXPERIENCE AS AN AËRONAUT.

COMPRISING

A HISTORY OF THE VARIOUS ATTEMPTS IN THE ART OF FLYING BY ARTIFICIAL MEANS FROM THE EARLIEST PERIOD DOWN TO THE PRESENT TIME.

WITH AN ACCOUNT OF

**The Author's Most Important Air-Voyages**

AND

HIS MANY THRILLING ADVENTURES AND HAIRBREADTH ESCAPES.

ALSO,

AN APPENDIX, IN WHICH ARE GIVEN FULL INSTRUCTIONS FOR THE MANUFACTURE AND MANAGEMENT OF BALLOONS.

BY JOHN WISE.

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"Stand still, and consider the wondrous works of God.

"Dost thou know when God disposed them, and caused the light of his cloud to shine?

"Dost thou know the balancings of the clouds, the wondrous works of Him which is perfect in knowledge?"—JOB xxxvii.

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I RESPECTFULLY DEDICATE

THIS WORK,

AS A TRIBUTE OF RESPECT AND ADMIRATION,

TO

PROFESSOR JOSEPH HENRY,

OF THE SMITHSONIAN INSTITUTE.

JOHN WISE.

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Drawn by W. L. SHEPPARD, F. B. SCHELL, F. W. SCHELL, E. B. BENSELL, LOUIS BLANC and other artists.

METEOROLOGICAL SECTION

OF THE

Franklin Institute of Pennsylvania.

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Cor Sec'y.

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New York Aug 26. 1873

Geo Maclean

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My Dear Sir

Yours of 23^d inst. recd. I am pleased to hear that "Through the Air" progresses so rapidly and that you will have a completed Copy of it ready for me to take across the Atlantic, should we be able to do so. My arrangements are also approaching Completion and I hope to make the start at an early day. May I hope to see you and the rest of my friends of "To Day" on hand at the departure to wish me a good bye and God-speed?

Truly and sincerely Yours John Wise

# PREFACE.

It is now more than twenty years since I made my first venture in authorship. Up to that time I had had only fifteen years of experience in the art of air-sailing, with very little to guide me outside of it, and very little to hope for from contemporaneous experience, save from occasional aërial voyages made by certain amateur aëronauts, which, in most cases, seemed to have been inspired by a love of adventure rather than a determination to discover the full merits of an art which is capable of being developed to real commercial importance.

A lapse of twenty more years, devoted to the pursuit of the profession, has served to reveal to me much to encourage the hope, so long cherished, that the era of aërial navigation is close at hand. Things that were once looked upon as merely problematical are now clearly understood and made part and parcel of acknowledged science and perfected art. I refer to the knowledge of the aërial tides known as the trade-winds, and the means by which air-floats can be kept aloft for considerable lengths of time—as long, indeed, as a sea-ship can be safely kept afloat on the ocean.

During all this period of nearly forty years I have made four hundred and forty-three balloon ascensions, some of them for pleasure, but most of them for purposes of observation and study; and as the incidents of many of these voyages were deeply interesting, as the grand results of my labors are, I trust, in a just sense, valuable to the cause of science, I have prepared this book so that the world may perceive what has been accomplished, may share with me the recollection of many exciting adventures, and may understand how the art of moving through the air has been developed to its present condition.

The student of aëronautics heretofore has been obliged to grope his way in the dark, in a great measure, as far as practical infor-

mation is concerned; while engaged in the investigation of the mysteries of the art, the details of the methods of manufacturing, inflating and managing balloons are scarcely touched in most works upon the subject, and what prescriptions and instructions are given are too often mere theoretical deductions, which are more apt to lead the student into difficulties than to promote the object of his pursuit. This arises from the circumstance that the writers in many instances are not practically acquainted with the subject of which they write, and this defective knowledge is particularly perceptible when such persons undertake to describe the preparation of varnishes and other requisites to the successful practice of ballooning.

It is, in fact, essentially necessary that a writer upon the subject should have acquired his knowledge in the school of experience in order to make his book valuable for the promotion of the art of navigating the air.

In the first portion of the present work I have devoted some space to the early history of aërial navigation. This always interested me, and I consequently have sought most diligently for all the information that could be obtained concerning earlier investigations and experiments. As regards that part of the work, it had to be necessarily brief, unless fabulous and superstitious accounts would have been taken as matter pertinent to the subject, which could hardly have been deemed admissible to a sober history.

With a few exceptions, plausible accounts and mathematical deductions were only considered, and these are interspersed among the romantic and fabulous stories which seem to have been built upon them. It was often difficult to find out who the real or original authors of these accounts were, and whether they were writing from personal knowledge or from hearsay. In regard to most of them, however, it would seem of little account to us, since the inventors of these flying machines mainly attribute the particular excellences of their discoveries to some patron saint's spiritual power, notwithstanding they used many wheels and pinions in their aërial apparatus.

In the account of my own long experience in the practice of ballooning, I have endeavored to combine the highest degree of interest to the common reader with as much useful instruction to the student of the art as my numerous and most interesting aërial

voyages have enabled me to produce. Meteorological phenomena, being so intimately connected with the practice and science of aëronautics, are described, as far as they developed themselves in my voyages, just as they presented themselves to my observation. I flatter myself that this part of the work will prove itself interesting to all classes of readers.

I have also embodied accounts of several of the most remarkable balloon voyages which have been made recently and in the comparatively early past by other voyagers in this country and Europe. Many of these narratives are in the highest sense entertaining and instructive, and they form a valuable addition to the history of the science.

The Appendix, which I have prepared with great care, comprises the philosophy, theory and practice of the art, with complete instructions for making all necessary aëronautic machinery. It is written with the purpose of bringing the subject fairly to the comprehension of the minds of the searchers, promoters and practitioners of the art, and is therefore given in the plainest style, easily to be understood. I believe that in this shape it will best attain the end for which it is designed.

We all live, or should live, to some purpose, and mine has been, during the whole of my life, over a space of nearly forty years, the attainment of that much-desired epoch prophesied by Bishop Wilkins, when he said that "the time will come when men will call for their wings when about to make a journey as readily as they do now for their boots and spurs." That, I trust, to a generous public, will be a sufficient excuse for one so poorly qualified entering upon the high ground of authorship in aëronautic literature.

JOHN WISE.

PHILADELPHIA, August, 1873.

# AUTOBIOGRAPHICAL SKETCH.

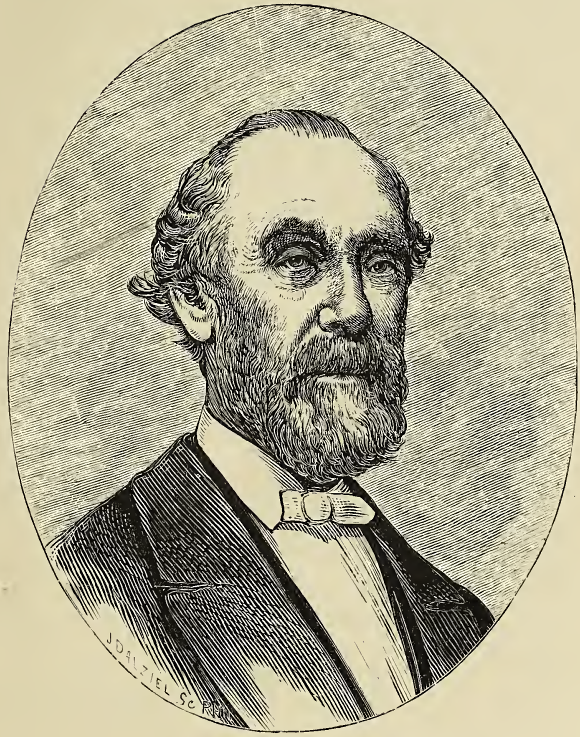
I WAS born in the city of Lancaster, Pa., on the 24th day of February, 1808. My father and mother were both born in the same place. My grandfather, on the father's side, was a German from Würtemberg, and on the mother's side an Englishman from London. I received an English and German education in the grammar-school, and afterward graduated at the high-school of Lancaster. While a scholar in the latter school I was kindly allowed a free admission to the library of the Rev. Wm. Augustus Muhlenberg, and also became a member of his Bible class. Under the auspices of this noble-hearted divine, I was inspired with desires for a higher order of learning. Theology at first seemed to me to hold out a paramount invitation for mental improvement, but the more I attempted to sound its mysteries, the more I became confused in its understanding, and I gave it up in despair, believing that the Lord had not appointed me for a theologian. This was my serious and sincere conviction. From theology my mind was directed to the appearance and motion of the heavenly bodies; and in their study my longings found a congenial field of thought, more, however, in the speculative than in the true mathematical direction.

I would spend hours in the night lying upon a straw-heap looking at the stars and the moon, and the arrival of a comet gave me rapturous joy. It was this kind of natural bent that first led me to indulge in aërial projects. The kite was a favorite toy with me, and many a kitten enjoyed an aërial ride as a bob-tail to this kind of vehicle long before I could enjoy it myself. How ardently I wished that these little animals could speak and tell me how it looked from on high! Sometimes I managed to get them into a cloud, and then my joy was unbounded. At night I would illuminate the kite with various colored paper lanterns, and compare

them to the different colored stars. My proficiency in kite construction led me to the idea of making one large enough to carry me up; but when I attempted to put my idea into practice, I found two insurmountable obstacles—first, a place large enough to make one in, and secondly, the cost of materials.

At the age of fourteen I read in a German newspaper an account of a balloon voyage in Italy, and that moved me to a study of that kind of aërostatic machinery. Tissue-paper parachutes were first experimented with. I would drop them from the house-top and from the church-steeple, and at other times let them ride up upon an ascending eddy of air caused by the angle of conjoined buildings. On one occasion the little parachute was caught upon a local whirlwind and lifted up into a cloud; and when I beheld its last glimmer as it buried itself in the misty deep, I fairly jumped for joy. Why could not a large one be made, with which I could, on a favorable opportunity, take a ride upon the whirlwind? Ah! the cost! At all events, let us try how the coming down is to be effected, in case the luck of getting up should in time come to hand. The kitten aëronaut had now grown to a full-sized tabby, and her experience in such matters qualified her for the experiment. Four large-sized ox-bladders were to act as the resisting surfaces to a too rapid descent. These were fastened to a girth that encircled the body of the cat, and away she was launched from the gable window of the house. She made a rapid but a safe descent; and if it had been from an elevation of a thousand feet, instead of thirty, as it was, she would, no doubt, have landed without hurt. That was my conclusion at the time, and it has not been altered since. The truth of this was verified in my manhood by two descents I made by exploding my balloon when two miles high, and coming down swiftly but safely by atmospheric friction.

The next essay was the ascent of a tissue-paper "fire balloon"—a Montgolfier. This proved to be a backsetter to my aërostatic progress. Not being skilled in this branch, the first experiment, although not entirely a failure in a scientific point of view, was of such a character as to bring me into trouble. The balloon went up several hundred feet, but in a few moments thereafter settled down on a thatched roof and set fire to it. Great were the emotions of my heart while viewing the calamity from a chink in the




John Wise

cow-stable. The fire-bells of the town—and these were alike the bells of the churches, the court-house and school-houses of the place—sounded the alarm of fire. The fire ranks were formed, fire-buckets were flying helter skelter, the street-pumps were pouring out their watery contents, the roof was in a blaze, and I was trembling from head to foot in fear that the building might be destroyed. The fire was soon extinguished, but not without sundry admonitions as to what might be the consequences to that devilish boy "if he set the town on fire again with his foolish tricks."

A year after that, when the thing was forgotten, I made another trial with a paper Montgolfier, and that proved a success and determined the profession of my life.

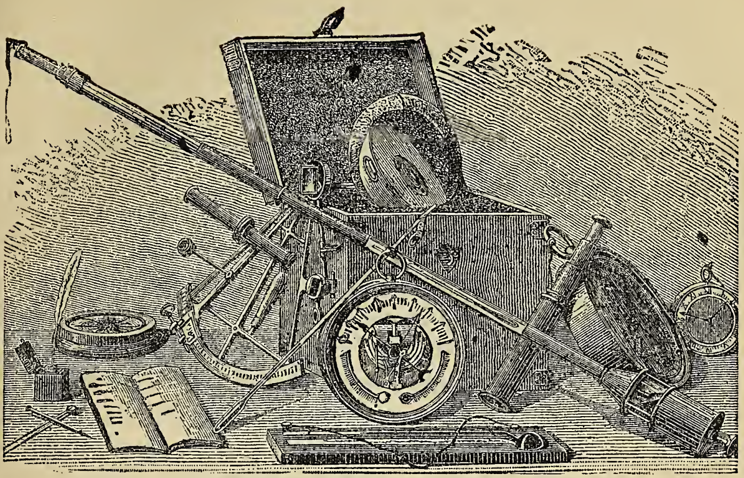
It may be added that a few years later I was apprenticed to the cabinet-making trade, in which I served four and a half years, became a proficient workman, and followed it up in piano-forte making, from which, in 1835, I departed to that of professional ballooning, which I have followed to this day, more from the scientific attractions it had than from the mere love of adventure and money-making.

I had constantly in my heart and mind "that there are more things in heaven and earth than are dreamt of in our philosophy."

Such, in brief, is the story of my life up to the time that I became a professional aëronaut. If the reader is interested in the doings of so humble an individual as myself, he will find the most important events of my career recorded in this volume.

JOHN WISE.

PHILADELPHIA, August, 1873.



AËRONAUTIC INSTRUMENTS.

# INTRODUCTION.

THE hope had been cherished by the author that before this work should be issued from the press he would have been enabled to chronicle some experimental trips from the American continent to particular localities in Europe. This idea was uppermost, on account of the importance it would give to a successful inauguration of a system of air travelling as contemplated in the thorough understanding of the trade-wind currents, and their uses as the means of making attainable any given point on the habitable globe by the simple process of "aërial drifting." However, the notable trips that have lately been made with balloons, the important use to which they have been given in the strategy of war, and the

general concentration of thought now evinced by pioneer scientists on the subject, are in themselves sufficient to justify a few remarks in this place. The *experimentum crucis* of a successful trans-Atlantic aërial voyage may nevertheless become subsidiary to the issue of the work.

The immediate object to be attained is in the dissemination of all the useful knowledge pertaining to the subject, and the encouragement to be given those desirous of entering the field of experiment by the positive usefulness already demonstrated in the practice of aërial transition in the most recent and important cases. Not only was the government of France—pent up in the city of Paris, as the Prussian generals supposed—enabled to hold communication with all the outside world, but even private individuals availed themselves of the means afforded by the balloon to get out of the beleaguered city and go on their ways rejoicing.

The noted astronomer Janssen, who happened to be in Paris at the time of its investment by the Prussian army, preparing the necessary instruments for his observations to be made on the then approaching solar eclipse, would have been deprived of opportunities for conducting his experiments had it not been for the balloon facilities which the emergency of the war brought into play. The minister of public instruction furnished him the balloon "La Volta," of 72,000 cubic feet capacity, and a seaman as aëronaut; and freighted with his apparatus for the observation, he took passage on the morning of the 2d of December, 1870, and landed safely beyond the Prussian war lines at St. Nazaire the same day. He was thus enabled to view the eclipse in proper style on the 22d day of December following.

It is worthy of remark that this system of ballooning, which proved of such inestimable value to the French people during the most trying period of the national existence, had not its inauguration through the wisdom and enterprise of the government, but owed its practical institution to individual enterprise. And it is ever so. Governments are always slower in the realization of a great development than individuals. Governments are intrinsically conservative; individuals, as a general rule, especially where genius is inherent, are intrinsically progressive.

The Parisians have learned what the invention of one of their own countrymen is worth; and in the hands of a people so emi-

nently scientific and intelligent, the art of aërial navigation should find an impetus worthy of its great civilizing tendency. Necessity is the mother of invention, and never before was this truism so magnificently illustrated and demonstrated as in the late siege of Paris. The mail facilities afforded to the pent-up people of the beleaguered city is not the only good that will come out of the balloon, because that was only an accidental advantage it afforded. Far greater developments rested within its ample and manifold uses—things that lay in the womb of its future, and which in due time will yet be brought forth for the benefit of mankind.

A repetition of such an investment would bring out of Paris something more than the crossing of the besieging lines with letter mails and carrier-pigeons. Balloons would be converted into engines of war. Moored over the investing lines, a terrific fire of shot, shell, choke-balls of suffocating combustibles, with showers of hand-grenades, could be poured from it, so as to render the investing ground utterly untenable.

The legitimate object of the balloon, however, seems to be more in the direction of commercial use as a means of transition, and for the scientific exploration of the atmosphere. We live in and under an ocean of matter of which much is yet to be learned. The atmospheric tides and the currents of the trade-winds are more intimately connected with our health and moral welfare than is generally supposed. When the true character of epidemic diseases and the nature of their propagation shall be more correctly understood, then shall we place a greater value upon the air-ship. The fact that we may have a freezing cold atmosphere on the surface of the earth, and a summer-tempered layer of air from ten to twenty thousand feet above, is one of the phenomena lately ascertained by the use of the balloon; and so with rain, hail and snow. How these differently-conditioned layers of air can exist, and do exist, one above the other, at the same time, is not yet clearly explained. Sharply-defined strata of frost and snow-producing air immediately above, and sometimes underneath, warm layers are of common occurrence in our latitude on warm summer days; and as these phenomena are noted late in the fall, it is not unlikely that they also prevail during the coldest winter season. While the weather signal service is founded upon the isobarometric lines of high and low barometric variation of atmospheric weight, it is not known

what brings about these waves of high and low atmospheric pressure. Our bodily health and mental activity are so dependent upon these phenomena that in some parts of the world it has become a proverb not to attempt any important business when certain atmospheric movements are in action. All these phenomena are yet to be reduced to scientific data by the use of the balloon.

When it was determined by the French government that balloons should become a part of its postal functions, and for the purpose of opening and keeping up communication with the outside world, it became a question of what material they should be made. Silk was dear, too, and not abundant, when it was considered that so much would be required in order to send off a daily mail balloon which would be capable of carrying from one to two tons of freight. The Godards, experienced aëronauts, were, however, equal to the emergency, and they suggested calico. Any one acquainted with this fabric of French manufacture is aware of its fine quality and its superiority of texture over goods of the same denomination made by other nations. Of this material all the French postal balloons were made, and remarkably well did they sustain the reputable superiority of French calicoes.

Dr. Janssen's voyage in the Volta balloon, which we have before referred to, deserves special notice. It was conceived in the interest of science and in the true spirit of progressive art. He was not satisfied with simply passing the Prussian war lines, but continued his voyage to the middle of the day and until the approach to the sea admonished him to alight. At 11h. 15m. he commenced his descent near the mouth of the Loire; and although the wind was strong, he landed with his instruments of observation in good order. He travelled nearly 300 miles in five hours and a quarter. His rapid descent was checked by the guide-rope, which was 1000 feet long, and it also afforded a ready means to those who came to his aid of securing the balloon.

Now, when it is considered that these balloons were made in the ordinary way—some of them with only one coating of prepared linseed oil, and at best only with two—and most of them sent off, with their mail freight, under the charge of persons who had never before sailed a balloon, and that nearly every one of the fifty-four thus sent off reached a point of safety, ballooning cannot be considered the risky business it is so universally characterized.

# FRENCH WAR-BALLOONS.

THE FOLLOWING IS A LIST OF THE BALLOONS SENT OUT OF PARIS DURING THE SIEGE.

| No. | Day of Departure. | Names of Balloons. | Aëronauts and Passengers. | Place and Hour of Departure. | Descent. | Remarks. |
|---|---|---|---|---|---|---|
| 1. | Sept. 23, '70. | Le Neptune, 52,000 cubic feet. | Duruof, alone. | Place St. Pierre, 8h. 30m. A. M. | Evreux. | 227 pounds of letters. |
| 2. | Sept. 25. | La Cité de Florence, 67,000 cubic feet. | Mangin and Grand-Champ. | Boulevard d'Italie, 1h. P. M. | Vernouillet. | 231 pounds of letters and 6 pigeons. |
| 3. | Sept. 29. | Les Etats-Unis, 25,000 cubic feet, and another of 17,000 cu. ft. | ........................................ | .............................. | .............................. | .................................................. |
| 4. | Sept. 30. | Le Céleste, 26,000 cubic feet. | Tissandier, alone. | Usine de Vaugirard, 10h. A. M. | Dreux, Normandy. | 176 pounds of despatches and pigeons. |
| 5. | Sept. 30. | A double paper balloon, 4,500 cubic feet. | .................. .......................... | Boulevard d'Italie, 1h. A. M. | .............................. | 59 pounds of despatches and proclamations. |
| 6. | Oct. 7. | L'Armand Barbés, 53,000 cubic feet. | Trichet, accompanied by Gambetta and his secretary. | Place St. Pierre, 11h. 15m. P. M. | Epineuse, 3h. 30m. A. M. | 22 pounds of despatches and pigeons. |
| 7. | Oct. 7. | Le Georges-Sand. | Three passengers. | Place St. Pierre, | .............................. | Without despatches. |
| 8. | Oct. 12. | Le Washington, 72,000 cubic feet. | Bertaux, Lefébvre and Vouroosbeck. | Orleans R.W. Station, 8h. A. M. | Carnieres, Nord. | 660 pounds of despatches and pigeons. |
| 9. | Oct. 12. | Le Louis Blanc, 70,000 cubic feet. | Fareot and Traclet. | Place St. Pierre. | .............................. | Without despatches. |
| 10. | Oct. 14. | Le Godefroy Cavagnac, 72,000 cubic feet. | M. Godard, sr., with Keratry and his two secretaries. | Orleans R.W. Station, 10h. A. M. | Bar-le-Duc, Brillon. | 374 pounds of despatches and pigeons. |
| 11. | Oct. 14. | Le Christophe Colomb, 72,000 cubic feet. | Tissandier, with Ranc and Féron. | Orleans R.W. Station. 1h. 15m. A. M. | Nogent, on the Seine. | 594 pounds of despatches and pigeons. |
| 12. | Oct. 16. | Le Jules Favre, 72,000 cubic feet. | Louis Godard, jun., with Malapert, Ribot and Beotè. | Orleans R.W. Station, 7h. 15m. A. M. | Belgium. | 429 pounds of despatches and pigeons. |
| 13. | Oct. 16. | Le Jean Bart, 72,000 cubic feet. | Labadier, with Barthèlémy and Dary. | Orleans R.W. Station, 10h. A.M. | Belgium. | 594 pounds of despatches and pigeons. |
| 14. | Oct. 17. | Le Victor Hugo, 70,000 cubic feet. | Nadal, alone. | Garden of the Tuileries, noon. | Belgium. | 968 pounds of despatches and pigeons. |
| 15. | Oct. 18. | La Liberté, 176,000 cubic feet. | M. Fonvielle intended to ascend in this balloon. | Usine de la Villette. | Le Bourget (in the Prussian lines). | This balloon broke away during the inflation. |
| 16. | Oct. 19. | Le Lafayette, 72,000 cubic feet. | Jossee, a seaman, with M. Dubost and his secretary. | Orleans R.W. Station, 9h. A.M. | .............................. | 671 pounds of despatches and pigeons. |
| 17. | Oct. 22. | Le Garibaldi, 70,000 cubic feet. | Iglésia and Jouvencel. | Garden of the Tuileries, 11h. 15m. A. M. | Meaux. | 990 pounds of despatches and pigeons. Descent in the Prussian lines, despatches saved in a dung-cart. |

FRENCH WAR-BALLOONS.—(*Continued.*)

| No. | Day of Departure. | Names of Balloons. | Aëronauts and Passengers. | Place and Hour of Departure. | Descent. | Remarks. |
|---|---|---|---|---|---|---|
| 18. | Oct. 25. | Le Montgolfier, 72,000 cubic feet. | Hervé, a seaman, with Col. Lapierre and Com. Legouedec. | Orleans R.W. Station, 8h. A. M. | ........................ | 638 pounds of despatches and pigeons. |
| 19. | Oct. 27. | Le Vauban, 71,000 cubic feet. | Guillaume, a seaman, with M. Leitlinger and Cassier, an owner of pigeons. | Orleans R.W. Station. | Between Metz and the frontier. | 594 pounds of despatches and pigeons. All saved. |
| 20. | Oct. 29. | Le Colonel Charras, 70,000 cubic feet. | Gilles, alone. | Northern R.W. Station. | Belgium. | 1012 pounds of despatches and pigeons. |
| 21. | Nov. 2. | Le Fulton. 72,000 cubic feet. | Leglorennec, a seaman, and Ozanne, an engineer. | Orleans R.W. Station, 8h. 45m. A. M. | ........................ | 550 pounds of despatches and pigeons. |
| 22. | Nov. 4. | Le Ferdinand-flocon, 70,000 cubic feet. | Vidal and Lemercier de Janval. | Northern R.W. Station, 9h. A. M. | ........................ | 286 pounds of despatches and pigeons. |
| 23. | Nov. 4. | Le Galilée, 72,000 cubic feet. | Husson, a sailor, and Etienne Antonin, an engineer. | Orleans R.W. Station, 2h. 18m. P. M. | Near Orleans. | 924 pounds of despatches and pigeons. Aëronaut and engineer made prisoners and sent to Germany. |
| 24. | Nov. 6. | La Ville de Châteaudun, 70,000 cubic feet. | Boc, alone. | Northern R.W. Station, 9h. 45m. A. M. | Roclainville (Eure et Loir). | 979 pounds of despatches and pigeons. |
| 25. | Nov. 8. | La Gironde, 72,000 cubic feet. | Galley, a sailor, with MM. Herbault, Gambés and Barry. | Orleans R.W. Station, 8h. 30m. A. M. | Gondreville, near Bordeaux. | 132 pounds of despatches and pigeons. They started expressly for Bordeaux. |
| 26. | Nov. 12. | Le Daguerre, 72,000 cubic feet. | Jubert, a sailor, with Mobécourt and Pierson, an engineer. | Orleans R.W. Station, 9h. 15m. A. M. | Ferriéres. | 572 pounds of despatches and pigeons. Made prisoners. Mai saved by a forester. Pierson made his escape. |
| 27. | Nov. 12. | Le Niépce, 72,000 cubic feet. | Pagano, a seaman, with Romainville, Herault, Dagron, Fernic, Poisot and Guocchi. | Orleans R.W. Station, 9h. 16m. A. M. | Chalons-sur-Marne. | Supplied with microscopic photographic apparatus. Part of the things were saved with difficulty. |
| 28. | Nov. 18. | Le General Uhrich, 70,000 cubic feet. | Bienbao, with Chapouil, and an owner of pigeons. | Northern R.W. Station, 11h. 15m. A. M. | Luzarches (Seine et Oise). | 176 pounds of despatches and pigeons. |
| 29. | Nov. 21.* | L'Archimède, 72,000 cubic feet. | Buffet, a seaman, with St. Valery and Jandas. | Orleans R.W. Station, 1h. A. M. | Castelzé (Holland), 7h. A. M. | 484 pounds of despatches and pigeons. Buffet was decorated by General Trochu. |
| 30. | Nov. 24. | La Ville d'Orleans, 70,000 cubic feet. | Rolier and Deschamps. | Northern R.W, Station, 11h. 30m. P. M. | Norway, 600 miles north of Christiania. | 550 pounds of despatches and 6 pigeons. |
| 31. | Nov. 25. | L'Egalite. | Fonvielle and passengers. | ........................ | Belgium. | ........................ |
| 32. | Nov. 28. | Le Jacquard, 70,000 cubic feet. | Prince, a seaman, alone. | Orleans R.W. Station, 11h. 15m. P. M. | Unknown. | 550 pounds of despatches and pigeons. A bag from the balloon was picked up in the Channel. |
| 33. | Nov. 30. | Le Jules Favre (2d), 70,000 cubic feet. | Martin and Ducauroy. | Northern R.W. Station, 11h. P. M. | Unknown. | 110 pounds of despatches and pigeons. Same fate as the Jacquard. |
| 34. | Nov. 30. | La Bataille de Paris, 70,000 cubic feet. | M. Lissajons and two passengers. | ........................ | Near the mouth of the Loire. | ........................ |

* After this date it was decided the ascents should be made at night.

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|---|---|---|---|---|---|---|
| 35. | Dec. 2. | La Volta, 72,000 cubic feet. | M. Janssen, the astronomer and Chapelain, a seaman. | Orleans R.W. Station, 5h. A. M. | St. Nazaire. | Without despatches. The balloon was given to Janssen by the Minister of Public Instruction. |
| 36. | Dec. 5. | Le Franklin, 72,000 cubic feet. | Marciat, a seaman, and a major-general. | Orleans R.W. Station, 5h. A. M. | ................................ | 220 pounds of despatches and 6 pigeons. |
| 37. | Dec. 5. | Le Denis-Papin, 72,000 cubic feet. | Demalin, a seaman, and MM. Delort, Robert and Montgaillard. | Orleans R.W. Station, 5h. A. M. | Chatenay, near Nantes. | 121 pounds of despatches and 6 pigeons. |
| 38. | Dec. 11. | Le Général Renault, 70,000 cubic feet. | Wolff and Larmanjat. | Northern R.W. Station, 2h. 15m. A. M. | ................................ | 143 pounds of despatches and 12 pigeons. |
| 39. | Dec. 15. | La Ville de Paris, 70,000 cubic feet. | Delamarne, with MM. Morel and Billebault. | Northern R.W. Station, 4h. A. M. | Solingen, Duchy of Nassau. | 143 pounds of despatches. Made prisoners. Delamarne escaped. |
| 40. | Dec. 17. | Le Parmentier, 72,000 cubic feet. | Paul, a seaman, with MM. Jules and Dedouet, microscopic photographer. | Orleans R.W. Station, 11h. 20m. A. M. | Gourgancon (Marne). | 264 pounds of despatches and pigeons. |
| 41. | Dec. 17. | Le Gutenberg, 72,000 cubic feet. | Perruchon, a seaman from Rosny, MM. Louisy, Levy and D'Almeida. | Orleans R.W. Station, 1h. 20m. A. M. | Ligny. | 330 pounds of despatches and pigeons. |
| 42. | Dec. 18. | Le Davy. 70,000 cubic feet. | Chaumont, a seaman from Rosny, and M. Deschamp, sent on postal service. | Orleans R.W. Station, 5h. A. M. | Roche-sur-Yonne. | 55 pounds of despatches and pigeons. |
| 43. | Dec. 20. | Le Général Chanzy, 70,000 cubic feet. | Farriche, with MM. de Lépinay, Julliac and Jonfryon. | Northern R.W. Station, 2h. 30m. A. M. | Municn. | 55 pounds of despatches and pigeons. Made prisoners. |
| 44. | Dec. 22. | La Lavoisier, 72,000 cubic feet. | Sauveur, a seaman, with M. Boisdeffre. | Orleans R.W. Station, 2h. A. M. | Benfort en Vallée (Maire et Loir). | 385 pounds of despatches and pigeons. |
| 45. | Dec. 23. | La Délivrance, 70,000 cubic feet. | Cauchet and Reboul, charged with a mission. | Northern R.W. Station, 3h. 30m. A. M. | ................................ | 242 pounds of despatches and 4 pigeons. |
| 46. | Dec. 24. | Le Rouget de l'Isle, 72,000 cubic feet. | Jahn, a seaman, with MM. Garnier, proprietor of the balloon, Clachant, Tarbé des Sablons and Grisal. | Orleans R.W. Station, 8h. A. M. | La Fertémacé (Orne). | 213 pounds of despatches and pigeons. |
| 47. | Dec. 27. | Le Tourville. 72,000 cubic feet. | Montet, a seaman, with MM. Niégé, Delalue and Simon. | Orleans R.W. Station, 3h. 45m. A. M. | Emontiers (Haute Vienne), 1h. P. M. | 352 pounds of despatches and pigeons. |
| 48. | Dec. 29. | Le Bayard, 72.000 cubic feet. | Reginensi, a seaman, with M. Ducoux, director of the Cab Comp. | Orleans R.W. Station, 4h. A. M. | Napoleon Vendéé, 10h. A. M. | 242 pounds of despatches and pigeons. |
| 49. | Dec. 31. | L'Armée de la Loire, 70,000 cubic feet. | Lemoine, alone. | Northern R.W. Station, 5h. A. M. | ................................ | 550 pounds of despatches and pigeons. |
| 50. | Jan. 4, 1871. | Le Newton, 72,000 cubic feet. | Ours, a seaman, and M. Brousseau. | Orleans R.W. Station, 4h. A. M. | Mortagne (Orne). | 209 pounds of despatches and 471 pounds of freight. |
| 51. | Jan. 9. | Le Duquesne, 72,000 cubic feet. | Richard, a seaman, with MM. Chemin, Lallemagne and Aymond. | Orleans R.W. Station, 8h. A. M. | ................................ | 220 pounds of despatches and 4 pigeons. This aëronaut was furnished with the helicoidal apparatus, the system of Labrousse. |
| 52. | Jan. 10. | Le Gambetta, 70,000 cubic feet. | Duvivier and the engineer, Léfebvre de Fourcy. | Northern R.W. Station, 3h. A. M. | ................................ | 48 pounds of despatches, 3 pigeons and 480 pounds of freight. |
| 53. | Jan. 11. | Le Kepler, 72,000 cubic feet. | Roux, a seaman, and M. Dupuis. | Orleans R.W. Station, 3h. 30m. A. M. | ................................ | 55 pounds of despatches, pigeons and 297 pounds of freight. |

FRENCH WAR-BALLOONS.—(*Continued.*)

| No. | Day of Departure. | Names of Balloons. | Aëronauts and Passengers. | Place and Hour of Departure. | Descent. | Remarks. |
|---|---|---|---|---|---|---|
| 54. | Jan. 13. | Le Monge, 72,000 cubic feet. | Raoul, a seaman, and M. Guignier, proprietor of the balloon, and a friend. | Orleans R.W. Station, 3h. A. M. | .................................. | Despatches and pigeons. |
| 55. | Jan. 13. | Le Général Faidherbe, 70,000 cubic feet. | Van Seymortier and Hurel. | Northern R.W. Station, 3h. A. M. | .................................. | 132 pounds of despatches, 3 pigeons and 4 sheep-dogs, intended to cross the Prussian lines and return to Paris with despatches in their collars. |
| 56. | Jan. 15. | Le Vaucanson, 72,000 cubic feet. | Clariot, a seaman, with Montrouge, M. M. Valade and Delante. | Orleans R.W. Station, 3h. A. M. | .................................. | 165 pounds of despatches and 3 pigeons. |
| 57. | Jan. 18. | La Poste de Paris, 70,000 cubic feet. | Turbiaux, Clairet and Cavaillhou. | Northern R.W. Station, 3h. 30m. A. M. | .................................. | 154 pounds of despatches and 3 pigeons. |
| 58. | Jan. 20. | Le Général Bourbaki, 70,000 cubic feet. | Mangin, jr., and Boisanfrey. | Northern R.W. Station, 5h. 15m. A. M. | .................................. | 275 pounds of despatches and 4 pigeons. |
| 59. | Jan. 22. | Le Général Daumesnil, 72,000 cubic feet. | Robin, a seaman, alone. | Eastern R.W. Station, 3h. 15m. A. M. | .................................. | 616 pounds of despatches and 3 pigeons. |
| 60. | Jan. 24. | Le Torricelli, 72,000 cubic feet. | Bely, a seaman, alone. | Eastern R.W. Station, 3h. A. M. | .................................. | 506 pounds of despatches and 3 pigeons. Descended in the Prussian lines. Mail saved and forwarded. |
| 61. | Jan. 27. | Le Richard Wallace, 70,000 cubic feet. | Emile Lacaze, alone. | Northern R.W. Station, 2h. 30m. A. M. | .................................. | 506 pounds of despatches and 2 pigeons. It is believed this one fell in the sea. |
| 62. | Jan. 28. | Le Cambrone. | Tritan, a sailor, alone. | Eastern R.W. Station, 5h. A. M. | .................................. | 44 pounds of despatches and pigeons. This was the last, and carried notice ordering the ships to proceed to Dieppe for the revictualling of Paris. |

The post-office department sent out fifty-four of these balloons, and they carried about 2,500,000 letters, aggregating a weight of ten tons. For four months this system of mail and passenger transition was successfully carried on from Paris. The carrier pigeons were provided with microscopic photographs of the latest London Times, which were fastened to the middle tail feather of the bird. In an hour or two they were delivered in Paris, when they were thrown on a screen, magnified for the use of the reporters, and thus issued in the evening papers of the city. In some instances private individuals left Paris in their own balloons, in order to get out of the beleaguered city.

Summing up the whole of these aëronautic transactions gives an importance to the balloon not easily ignored by the usual flippant cry of its non-utility and danger.

In nothing is the New World so far behind the Old as in this matter of air travelling, considered as an art invested with the highest attributes of science and physical phenomena. None of the most noted scientists of America have ever yet ventured upon an exploration of the upper regions of the atmosphere. In Europe it found as its early inquirers men of the highest order of intelligence—men who were able and willing to grapple with the mysteries of nature wherever and however to be found. Mont Blanc and Popocatapetl were not the only heights that measured the diligence of their investigations. The first, and one of the most remarkable, aërial voyages that ever was made, found its patron in the learned duc d'Arlandes and his friend Pilâtre de Rozier. Members of the Academy of Sciences were engaged in the practical investigation of aërial science. Diplomats and distinguished naturalists made day and night voyages. Professors of note and scientific women engaged in ballooning during its earlier days. Zacharof the academician, Count Zambeccari, Dr. Giassati, Gay-Lussac and Brioschi were among its practitioners. At a later period we find Robert Holland, a member of Parliament, and Monck Mason making a voyage from London to Weilburg, in Germany, under the aëronautic direction of Charles Green; and later still we find Gambetta and his secretary leave Paris with a balloon, besides a number more of government officials at various times during the investment of Paris. Giffard, the inventor of the "Giffard Injector," is now one of the most active men in the world

in the investigation of this noble art. Fonvielle, Tissandier, Flammarion and Glaisher, of the Royal Astronomical Observatory, have been for the past few years illuminating the pages of scientific literature with the experience of their numerous day and night voyages.

With all this array of scientific talent and enterprise in the pursuit of knowledge on this great subject, as exemplified in the above-mentioned European scientists, it becomes almost a wonder that we find none of the same kind of men engaged in it in this country, especially when we consider that America is so forward in all that makes man a progressive being. It certainly cannot be attributable to the want of personal courage, because the practice of the art of ballooning in proper hands is as destitute of personal danger as railroad riding or sea sailing. Forty years of its experience in four hundred and forty-seven aërial voyages, day and night, and one of over a thousand miles, partly in the midst of a tornado, in the person of the writer, in itself goes far to show that its practice is not fraught with more than ordinary danger to life and limb when all necessary precautions to safety are taken.

The only American of note who ever ventured on an aërial voyage was Dr. Jeffries, who accompanied the first greatly distinguished aëronaut, Blanchard, in his famous voyage across the British Channel. Had Dr. Jeffries not been at the time in Europe, even this single case would not have fallen to the early credit of American enterprise and fame. It was not until a long time after the invention of the balloon that any American undertook to construct and sail with one of these aërial ships. Durant and Mills led the way with silken balloons, but it fell to the lot of the writer to introduce the art in more humble costume by using the common fine domestic shirting muslin, bringing it, in the experimental line of operation, within the reach of moderate expenses, as inaugurated in his first voyage, in 1835. Still, the art was slow in its American development on account of its being held as a dangerous if not presumptuous business, and it was not until some twenty years ago that ballooning became popular in America.

# PART I.

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# HISTORY OF FLYING BY ARTIFICIAL MEANS.

# THROUGH THE AIR.

## CHAPTER I.

Introduction—Archytas' artificial flying pigeon—Antonius Byerlink's account—Deception on the Emperor Basil of Macedonia—Roger Bacon on air sailing—His ingenious writings interdicted—Training up children to fly—Running and flying.

FROM the records of the earliest history, we learn that the mind of man was diligently directed to the investigation and discovery of the art of flying, and navigation of the atmosphere. That such a desire has been co-existent with the earliest advances of civilization, is not strange, nor to be wondered at, when we behold the easy and graceful faculty of locomotion enjoyed by the feathered race. There are few of us who have not viewed the flight of our native hawk and vulture with mingled feelings of envy and admiration. To see them soaring aloft, with apparently motionless wing, until the eye can scarcely trace them in the mazy heights of the atmosphere, at once excites the mind to a desire of enjoying their mode of transition, which, together with its speed and facility, would also enhance the intellectual privilege of feasting upon the wide expanse of beauty which adorns the earth beneath the aërial traveller. The ancients, for a long time, attributed this felicitous prerogative of the feathered race to a supernatural agency, and consequently looked upon them as species of deities. Many traditions of this sort are handed down to us through heathen mythology.

The ancient path of knowledge was obscure and intricate, until the superstitious notions of horned deities, flying oracles, and winged horses, began to be dispelled from the pages of philosophy. The unlearned in ancient times looked upon the operations of the artist with fear and reverence, while the initiated, through motives of self-aggrandizement, wrapped the veil of mystery more closely around

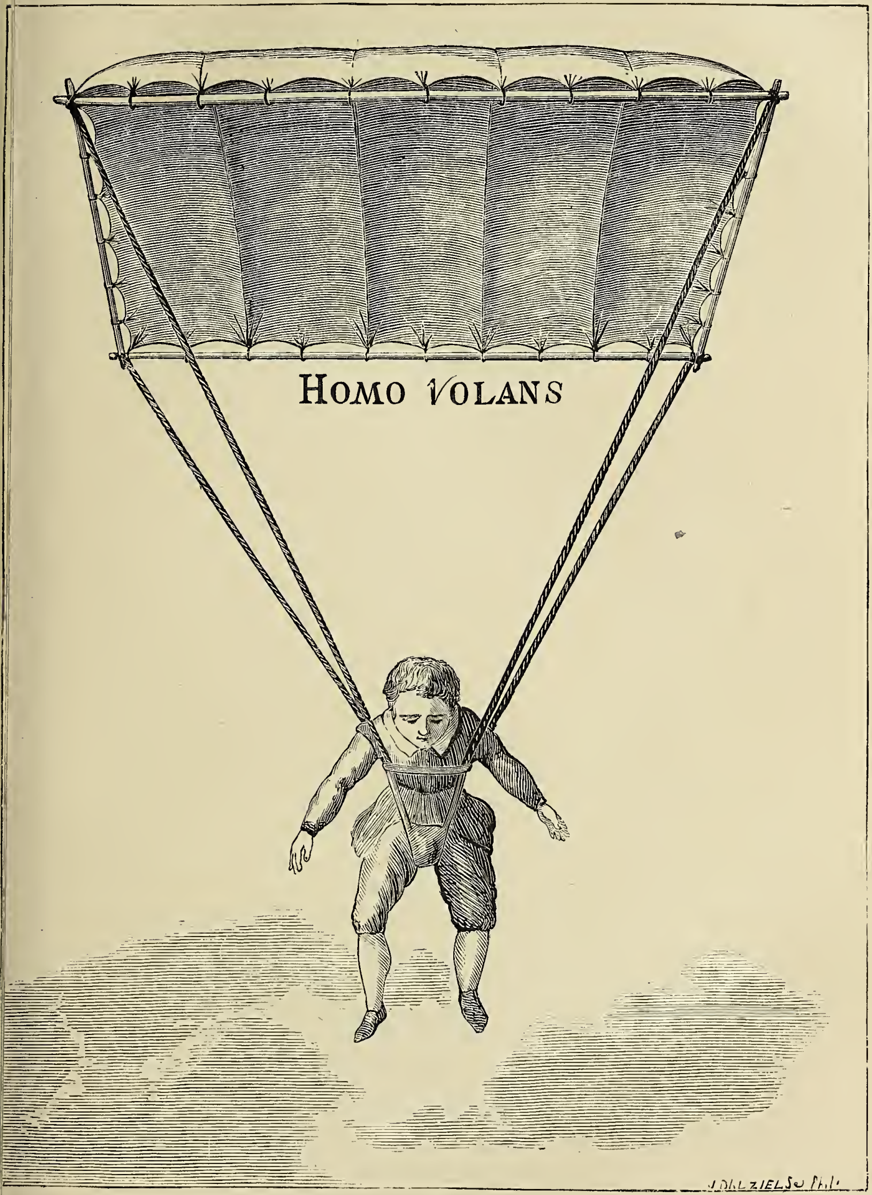
their learning. During later ages, in which natural philosophy began to take the place of superstitious mysteries and occult delusions, the arts and sciences progressed more rapidly; and since the art of printing has been discovered, mankind has become more equalized in the pursuit of knowledge. From that period, history and ingenuity assumed a nobler feature; the monopoly of learning, possessed and exercised by a chosen few, was broken up; the invention of John Faust, in the hands of John Gutenberg, started a new era in 1470, which gave a new and vigorous impulse to all kinds of improvement within the province of mankind. The faculty of flying, as well as other mysteries, was thenceforth examined more upon natural principles, in order to test the possibility of applying it to the use of the human family.

But let us return, for a moment, to the earliest writings for accounts of machines for traversing the upper heavens, and bring down a connected history of man's propensity to acquire so desirable an art to the present time. We shall then surely see, if not in the present, at least in an approximating future, a very encouraging prospect of its fullest realization, not merely as a means of pleasurable enjoyment, but also to carry on the most extended and magnificent commercial and scientific pursuits.

The first account on this subject that we find on the records of history, that carries with it anything like plausibility, and to which nearly all modern writers on the art of flying make reference, is that of Archytas' artificial pigeon. This great geometrician was of the Pythagorean school, and flourished about four hundred years before the Christian era. The account of it is given by the historian Aulus Gellius, who wrote during the time called the "Brazen Age." He says that "Archytas constructed a wooden pigeon which could fly by means of mechanical powers and an *Aura Spirit.*" In the description of the construction of this artificial flying pigeon, the machinery is in some measure explained. Its buoyancy seems to have been effected by magnets; but the moving, or rather the propelling, power is attributed to an occult—a very indispensable accompaniment to ancient works of wonder, of which we have *only* descriptions.

Another writer, in reference to this artificial bird, says: "Archytas, philosopher of Taranto, constructed a wooden pigeon which could fly; but if it fell to the ground, it could not raise itself up again."

Much has been written about this wonderful piece of art during the last three centuries, the most important being found in the writings of Cardan, Scaliger, Fabri, Lana, and others. But most of these authors, like the historian Gellius, have their descriptions involved with obscure proceedings—throwing but little light on the path of discovery of aërostation. Writers of a more modern date intimate that by the enclosed "aura spirit" might be meant rarefied air, or hydrogen gas, and the mechanical artifice connected with it, to have been used for the purpose of giving it direction. These suppositions fall to the




"HOMO VOLANS."

ground when we examine the subject closely. If gas or rarefied air had been used to give it buoyancy, the machine would necessarily have been of great size, so much so, that it could hardly have retained much resemblance to a pigeon. All the writers who refer to the subject call it a pigeon, and yet none of them make mention of its being of extraordinary size. Besides this, the process of inflation, either with rarefied air or hydrogen gas, would have been so conspicuous a part of its operations, that it could not well have been overlooked by those who saw it and wrote about it, without some account of the process being given in its history. It is not in the least probable that Archytas had any knowledge of the gases—and it is also very doubtfully maintained that he made his pigeon fly to any considerable extent or height. Such an opinion is confirmed by the writer who says, "When it fell to the ground, it could not raise itself up again."

It would be unnecessary to go into a critical investigation of the merits of Archytas' invention, were it not that nearly all subsequent accounts of flying machines are too dependent upon this tradition for their proof of success, many of them blending it with their own fanciful notions, and throwing around them an air of mystery and secrecy well calculated to delude the unlearned into the belief that it required the aid of a spiritual agency, which could only be acquired by those whose learning entitled them to hold communion with saints and demons.

It is not remarkable that, at a period when all civilized Europe was shrouded in ignorance, and labored under the tortures of iron-handed tyranny, such doctrines should have elicited the admiration and awe of the multitude, and more especially so, when even the tenets and history of the church of that day were embellished with accounts of flying temples, flying dragons, flying saints, and flying witches.

The next account that we find particularly noticed in history is that of a man who, it is said, flew high in the air in the city of Rome, under the reign of Nero, but lost his life in the descent—an unfortunate fatality which terminated many of the ancient experiments in flying. This adventure is related by Antonius Byerlink, who endeavors to substantiate the circumstance by a description of the ingenuity and mathematical precision of the artist's wings and apparatus; but concludes with a vague intimation that the individual's evil genius became displeased with him when aloft, and consequently suffered him to fall down.

Here, again, we find that the machinery, critically exact as it may have been, could not of itself accomplish the design for which it was constructed. The apparent flight of these objects must have been delusive. At that period, the magic art was expertly practiced. We have an example in the case of the emperor Basil of Macedonia, as it stands written in "Brewster's Letters on Natural Magic."

"Inconsolable at the loss of his son, this sovereign had recourse to the prayers of the pontiff Theodore Santabaren, who was celebrated for his power of working miracles. The emperor, in short, saw the aërial image of his son on horseback, and as the picture was brought

nearer the mirror, the image advanced into his arms, when it, of course, eluded his affectionate grasp."

This art being well understood by the ancients, may have been the means of giving effect to the delusion of flying machines, such as Archytas' pigeon, and others referred to by those historians.

Roger Bacon, an eminent philosopher of the thirteenth century, who, from his genius and ability, won for himself the title of "The Admirable Doctor," was the first to whom we are indebted for an approximation to the true principles of aërostation. He wrote upon various subjects, and displayed in all a great power of imagination, with an equal degree of enterprise. The knowledge he possessed, and the theories he laid down, appear the more remarkable because we have, within the last hundred years, realized several of his most magnificent schemes. Like Franklin, his ideas and knowledge were three or four centuries ahead of the age he lived in. The art of sailing in the air, or, at least, the principle by which it is accomplished, seems to have been so well understood by him, that we may safely ascribe to him the discovery of its main principle (atmospheric buoyancy).

In one of his works he descants in glowing language on the possibility of constructing engines of immense size and power, that could traverse the land and the water with great speed, and carry with them persons and merchandise. He then goes on to describe a plan of navigating the air. He assumes that the atmosphere is a material of some consistency, capable of bearing upon its *surface* vessels, as ships are borne upon the surface of the water. He next describes the construction of his aërial machine, "which," he says, "must be a *large hollow globe* of copper, or other suitable metal, wrought extremely thin, in order to have it as light as possible. It must, then," he says, "be filled with 'ethereal air or liquid fire,' and then launched from some elevated point, into the atmosphere, where it will float like a vessel on the water." It cannot be ascertained, from the writings of Roger Bacon, that he ever realized any of his grand projects of flying, by actual experiment; but, in concluding his treatise upon this branch, he expresses himself thus: "There is certainly a flying instrument, not that I ever knew a man that had it, but I am particularly acquainted with the ingenious person who contrived it."

After expressing himself so confidently upon the "hollow globe" method, he thinks, "There may be made some flying instrument, so that a man sitting in the middle of the instrument, and turning some mechanism, may put in motion some artificial wings which may beat the air like a bird flying."

To these descriptions of Bacon, some of our modern writers have adverted with greater zeal than judgment, to prove that the art of flying by human contrivances was known to the ancients, or, at least, anterior to the discovery of the Montgolfiers. They contend that Roger Bacon was well acquainted with the properties of the atmosphere. Some very learned disquisitions have been written to prove

that his *ethereal air* and *liquid fire* were the same as our rarefied air and hydrogen gas.

With all due deference to the brilliant genius and far-reaching intellect of Roger Bacon, it must still be evident from his own writings that he did not fully understand the principle of atmospheric pressure, or he would not have thought it necessary to get his "hollow globe" on the surface of the atmosphere. As to his having some knowledge of the consistency of the air as an elastic fluid, that will not be denied, for at that period the attention of the learned began to be directed to the science of pneumatics; but we have no authenticated writings to show that they had a knowledge of the various and distinct gases.

The discovery of the art of making gunpowder has been attributed to Roger Bacon, and history makes it evident that he accomplished astonishing things in his day, for we read that he was accused of holding communion with the devil, and that the perusal of his writings was interdicted by an order of Nicolas IV., and the doctor placed under personal restraint, where the emanations of his brilliant mind could only enlighten the emperor and his courtiers. Soon after Bacon's time projects were instituted to train up children from their infancy in the exercise of flying with artificial wings, which seemed to have been the favorite plan of the flying philosophers and artists of that day. If we credit the accounts of some of their experiments, it would seem that considerable progress was made in that way. The individuals who used the wings could skim over the surface of the earth with a great deal of ease and celerity. This was accomplished by the combined faculties of running and flying. It is stated that by an alternately continued motion of the wings against the air, and the feet against the ground, they were enabled to move along with a striding motion and with incredible speed.

If we are permitted for a moment to digress from the historical part of our subject, we will show that this method of locomotion, under the present knowledge of aëronautics, could be turned to considerable account. If, for instance, we take a balloon of limited size, about eighteen feet in diameter each way, it will, when inflated with hydrogen gas, be capable of raising 160 pounds, independent of its own weight. Now, if this be so fastened to a man's body as not to interfere with the free use of his arms and legs, he may then ballast himself so as to be a trifle heavier than the upward tendency of the balloon, which will be nearly in equilibrio. If, then, he provides himself with a pair of wings, made on the bird principle, with socket joints to slip over his arms at the shoulders, and a grasping handle internally of each one, at the distance from the shoulder joint of the wing as the distance is from his shoulder to his hand, he may beat against the air with his wings, and bound against the earth with his feet, so as to make at least a hundred yards at each bound. This the writer has often done, in the direction of a gentle wind, with the aid

of his feet alone, after his balloon had descended to the earth, and on one occasion traversed a pine forest of several miles in extent by bounding against the tops of the trees. Such a contrivance would be of inestimable value to exploring expeditions. Landings to otherwise inaccessible mountains, escapes from surrounding icebergs, explorations of volcanic craters, traversing vast swamps and morasses, walking over lakes and seas, bounding over isthmuses, straits and promontories, or exploring the cloud-capped peaks of Chimborazo, could all be easily accomplished thus.

FLYING MAN.

# CHAPTER II.

Famous John Muller and his artificial eagle—Dante of Perouse's flight—Cuperus on flying—Bishop Wilkins' propositions on air sailing—Philosophical approximations to the art—Jesuit Lana on air sailing—Besnier's flight—Baldwin bought his wings—De Gusman's petition for a patent for flying—De Bourgois' account—Gallien's book on flying.

IN resuming our history, it is related by several authors, each of whom seems to have copied the story from his predecessor, that the famous John Muller, also called Regiomontanus, constructed an artificial eagle at Nuremberg, which flew out to meet the emperor Charles V., and accompanied him back to town. It is also stated: "About the same period, and in succeeding times, we are told of a certain monk, named Elmerus, who flew about a furlong from the top of a tower in Spain. Another flight was attempted from St. Mark's steeple, in Venice, and one also at Nuremberg; and by means of a pair of wings a person named Dante of Perouse was enabled to fly, but while amusing the citizens with his flight he fell on the top of St. Mary's church, and broke his thigh."

Cuperus, in his treatise on the "Excellence of Man," very ingeniously contends that it is possible for human beings to attain the faculty of flying. He asserts that Leonardo da Vinci, the great painter, practiced it successfully, but his account is not well authenticated.

The next writer upon this subject who merits particular attention we find in John Wilkins, lord bishop of Chester, who died in the year 1672. In a work which he entitled the "Discovery of the New World," he says: "It is a pretty notion to this purpose, mentioned by Albertus de Saxonia, and out of him by Francis Mendoca, that the air in some part of it is navigable, and that upon this static principle any iron or brass vessel (suppose a kettle) whose substance is much heavier than that of water, yet being filled with air, it will swim upon it, and not sink. So suppose a cup or wooden vessel upon the outward borders of the atmosphere, the capacity of it being filled with fire, or rather ethereal air; it must necessarily upon the same ground remain there, and of itself no more fall than an empty ship can sink."

Wilkins' reasoning here embodies the sentiments and principles of

Bacon on this subject, with, however, quainter illustrations to show that the atmosphere is navigable. In tracing the progress of knowledge in relation to the principles of atmospheric buoyancy, it exhibits to the mind a very striking exemplification of the nearness to which we may approach the desired object of our pursuits, and yet, for the want of knowing correctly the application of a trifling part of it, how long we may be baffled in perfecting our schemes.

We find here that for the space of over 400 years one generation after another conceived more or less fully the principles and truths of a theory, without any real success toward its consummation in practice. The idea thrown out by Roger Bacon of atmospherical buoyancy, it does seem from history, had become the favorite theory with the most philosophical portion of the advocates of the doctrine that flying through the air could be accomplished by human beings. The other portion, who were evidently more of a mechanical turn, contended that it must be accomplished, by the aid of artificial wings, on the bird principle. Now, that it is not philosophically disproved that man may fly by the aid of artificial wings is evident, for it would be no more at variance with the laws of nature than it is for him to swim in the water like a fish.

While Cuperus, upon the one hand, in his treatise on the "Excellence of Man," contends that the faculty of flying by the use of artificial wings fastened to the body of a man can be attained, Borrelli, a Neapolitan mathematician, asserts that, after having examined the subject with great nicety, in a comparison of the strength of the muscles of a man to the muscles of a bird, it is impossible to fly by means of wings fastened to the body. Under this view of the subject, we may safely steer a middle course, neither denying the one nor positively assuming the other, but leaving to the age of improvement in which we live to decide, by actual experiments, what may be accomplished by both plans.

Bishop Wilkins, in his treatise on mechanical motion, treats expressly of the art of flying by the aid of wings. In the sixth chapter he says: "Scaliger conceives the framing of such volitant automata to be very easy. *Volantis columbæ machinulum, cujus autorem Archytam tradunt vel facillime profiteri audeo.*"

"But this may better be performed by the strength of some such spring as is commonly used in watches. This spring may be applied unto one wheel which shall give an equal motion to both the wings, these wings having unto each of them another smaller spring by which they may be contracted and lifted up, so that being forcibly depressed by the strength of the great and stronger spring and lifted up again by the other two. According to this supposition, it is easy to conceive how the motion of flight may be performed and continued."

Not so very easy, we should suppose, especially in continuing the flight, unless it would be a flight of fancy, which we shall presently show the bishop to have been more expert in than in any other depart-

ment of genius. In his seventh chapter he lays down four different plans by which flying in the air has been or may be attempted, to wit: "Firstly, by spirits or angels; secondly, by the help of fowls; thirdly, by wings fastened immediately to the body; and fourthly, by a flying chariot."

The first one of these propositions is an inheritance of the ancient superstition, as related by Aulus Gellius, in ascribing the power of Archytas' wooden pigeon to an *aura spirit*, and Antonius Byerlink's *evil genius*, which seems to have been the mainspring to this flying artist's machinery.

The second, which depends upon the help of birds, might to some extent be realized by the training of some such powerful bird as the condor of South America, which, it is said, can fly off with a sheep or a calf. But such a mode would not seem to be very promising in its results, admitting that it were practicable.

The third, which is to be accomplished by the aid of wings fastened immediately to the body, he recommends more in detail. Regarding this plan, he says: "It is the obvious and common opinion that this may be effected by wings fastened immediately to the body, this coming nearest to the imitation of nature which should be observed in such attempts as these. This is that way which Fredericus Hermanus, in his little discourse *De Art Volandi*, doth only mention and insist upon; and if we may trust credible story, it hath been frequently attempted, not without some success. It is related of a certain monk, called Elmerus, about the Confessor's time, that he did by such wings fly from a tower above a furlong, and so another from St. Mark's steeple, in Venice; another at Nuremberg; and Busbequius speaks of a Turk in Constantinople who attempted to fly. Mr. Burton, mentioning this quotation, doth believe that some new-fangled wit will some time or other find out this art. Though the truth is most of these artists did unfortunately miscarry by falling down and breaking their arms or legs, yet that may be imputed to their want of experience, and too much fear, which must, of course, possess men in such dangerous and strange attempts. Those things that seem very difficult and fearful at the first may grow very facile after frequent trial and exercise; and, therefore, he that would effect anything in this way must be brought up to the constant practice of it from his youth, trying first only to use his wings, in running on the ground, as an ostrich or tame goose will do, touching the earth with his toes, and so on by degrees learn to rise higher, till he shall attain unto skill and confidence. I have heard it from credible testimony that one of our nation hath succeeded so far in this experiment that he was able, by the help of wings, in such a running pace, to step constantly ten yards at a time."

In the same chapter he says: "But now, because the arms extended are too weak and easily wearied, therefore the motions by them are like to be but short and slow, answerable, it may be, to the flight of such domestic fowls as are mostly confined to the ground, which of them-

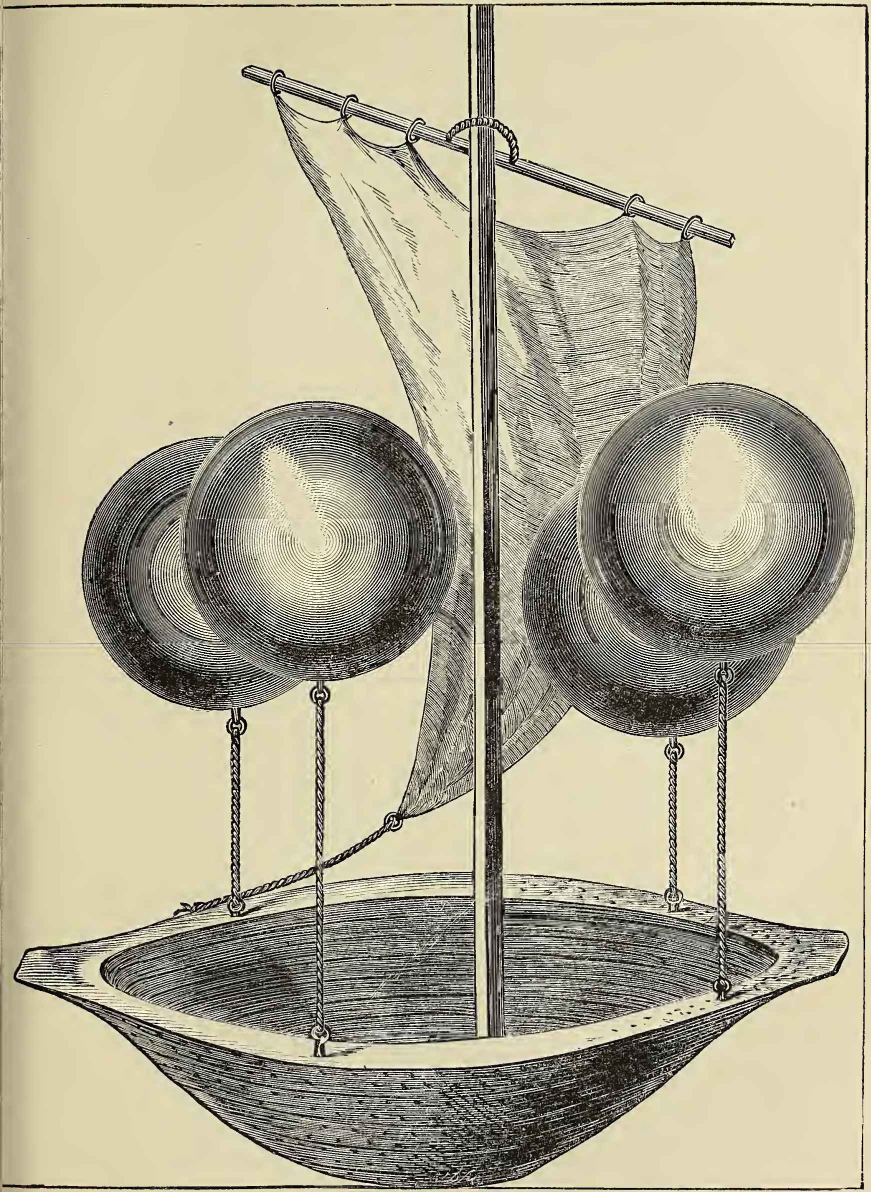
selves we see are quickly weary, and therefore much more would the arm of a man, as being not naturally designed to such a motion."

"It were therefore worth the inquiry to consider whether this might not be more probably effected by the feet, which are naturally more strong and indefatigable; in which contrivance the wings should come down from the shoulders on each side, but the motion of them should be from the legs, being thrust out and drawn in again alternately, so that each leg should move both wings; by which means a man should, as it were, walk or climb up into the atmosphere, and then the hands and arms might be at leisure to help and direct the motion, or for any other service calculated for them. This conjecture is not without strong probability and some special advantages above the other."

Now comes his favorite project, and one which has frequently been attempted, but invariably without the least success: "But the fourth and last way seems unto me altogether as probable, and much more useful than any of the rest, and that is a flying chariot, which may be so contrived as to carry a man within it; and though the strength might perhaps be serviceable for the motion of the engine, yet it were better to have it assisted by the labor of some intelligent mover, as the heavenly orbs are supposed to be turned. And therefore, if it were made big enough to carry sundry persons together, then each of them in their several turns might successively labor in the causing of this motion, which thereby would be much more constant and lasting than it could otherwise be if it did wholly depend on the strength of the same person. This contrivance being as much to be preferred before any of the other as swimming in a ship before swimming in water."

Now, some writers have warmly contended that Bishop Wilkins discovered the art of flying. So far from this being the case, the most plausible part of the plan suggested by him is taken from Roger Bacon's treatise on the subject, and that is essentially the balloon principle. He appears to have been very sanguine that the art could be attained, and much credit undoubtedly is due him for the assistance he has rendered the progress of its discovery. He expressed himself at one time to the effect that he believed the time would come when it would be as common for a man to call for his wings when about to prepare for a journey as it was in his time to call for boots and spurs. From the further investigations and quotations that we will make, it will be seen that Roger Bacon's principle was kept sight of by his successors, in the pursuit of this subject, until it was consummated and realized by the Montgolfiers and the committee appointed on this subject by the Academy of Arts and Sciences of Paris.

The philosophers, from Bacon's time down to the discovery of the true nature of atmospheric pressure, as illustrated by the Torricellian tube and air pump, in their speculations upon aërial navigation, all had an opinion that the atmosphere had a defined limit or border, not very high above the earth, upon which the aërial vessel must necessarily be placed in order to have it buoyed up by the air underneath,



LUNA'S MACHINE.

like the water under a ship. Reasoning from their knowledge of hydrostatics, they took it for granted that the atmosphere was a vast ocean of air surrounding our globe, upon the outer border of which rested another ethereal ocean of a much rarer kind, separate and distinct, as the air rests upon the water. Still they approached nearer, in each succeeding generation, to an attainment of navigating the air. Judging, then, from the scanty knowledge they possessed of pneumatics, and indeed of all the sciences, they are entitled to a great deal of credit in regard to the art of aërial navigation, as also to other important subjects. It does seem that, if the progressive individuals of our generation were to apply themselves with the same earnestness to this subject now that those before us whom we have made reference to did, it would not be long before we should see air travelling as much preferred and in advance of steamboat and railroad travelling as the latter are now in advance of the old-fashioned stage-coach and schooner methods. In the course of our history we shall see that the discovery by the Montgolfiers created a spirit for its advancement so far beyond a legitimate end that we may ascribe to it much of the apathy that has followed it. At the present time there is, however, a new and sober determination growing up again in the way of improving this neglected art.

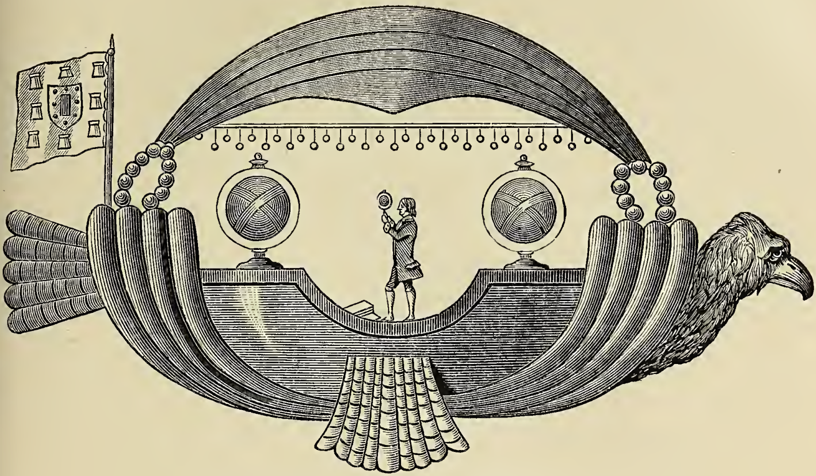
The great interest that was manifested in the seventeenth century, from the numerous experiments that were going on in every civilized part of the world, brought into the field many able writers on this subject, which soon revived all the knowledge and history of the past, and created a fresh stimulus to the investigation of all matters that had any bearing on or relation to the improvement of aërial navigation. Hypothetical narrations had now to give way to the more solid principles that naturally suggested themselves under such a state of improvement. Mathematical demonstration was resorted to as the only sure guide to direct the progress of the arts, and thus the veil of mystery could no longer cover the vague pretensions of monopolized learning. The researches of alchemy had also contributed many valuable discoveries toward strengthening the rational philosophy of the day, and from about this period we date the beginning of the most important and useful improvements in the operations of mankind.

Francis Lana, a Jesuit, and a very judicious writer, deduced from the new discoveries the real nature and pressure of the atmosphere, and is the first who established a theory verified by mathematical accuracy and clearness of perception, which placed him far in advance of his predecessors in the science of aërial navigation. He very truly inferred that a vessel exhausted of air would weigh less than when full of that fluid. He also shows in his problems that the capacity of globular vessels increases much faster than their surfaces. For example, take two globular vessels, one of ten feet diameter and another of twenty feet diameter; the first will have a capacity of 523 cubic feet and a fraction over, while the other will have 4189 cubic feet. The

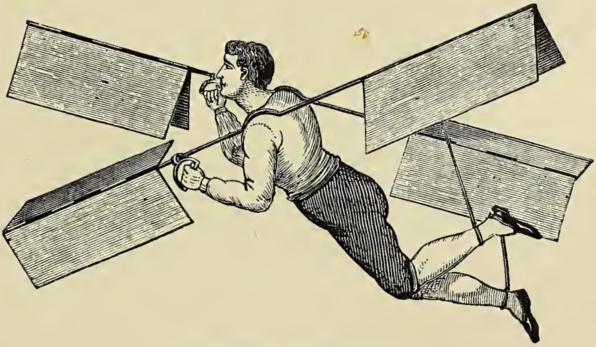
surface of the larger is about four times that of the smaller, while its capacity, or contents, is eight times as great. This is a very important consideration in the construction of balloons. Thus, a balloon capable of carrying one person would weigh one hundred pounds, while one capable of carrying two persons would not weigh more than one hundred and fifty pounds. Now, a balloon of the power first mentioned would be about twenty feet in diameter, which, when filled with ordinary hydrogen gas, would have an ascending power of two hundred and fifty pounds, while one of five times its diameter, being one hundred feet, would have an ascending power of thirty-two thousand seven hundred and twenty-five pounds, which would be capable of carrying one hundred and sixty-six men, independent of its own weight and necessary appendages.

Lana proposed to prepare four hollow globes of copper, each twenty feet in diameter, and so thin that they would weigh less than an equal bulk of atmosphere when they were exhausted of air. To these globes he designed fastening a boat, in which the aëronaut and his appendages were to be stationed, for the purpose of directing the machine. Although the idea laid down here involves the same principles by which aëronautics are practiced at the present day, still, several obstacles present themselves which must have rendered his plan impracticable. The copper of which the balloons were to have been made must necessarily have been so thin, to make the vessels light enough, that they would not have been strong enough to resist the external pressure of the atmosphere when they were exhausted.

The barometer, by which the pressure of the atmosphere is ascertained, was discovered in 1643. The immense weight of the air, as shown by the Torricellian tube, being about fifteen pounds to every square inch of surface, was no doubt the stimulus to Lana's proposition of the copper globes. His work, entitled "Pro Dromodell' Arte Maestra Brecia," in which he describes his machine, appeared in 1670, before the air pump was invented, or at least its invention was not made known until the year 1672. The great pressure of the air, as shown by the barometer, without a knowledge of its specific gravity, would very naturally induce a belief that it possessed a much greater weight than it really has, which is one and two-tenth ounces to the cubic foot. At this rate, Lana's globes of twenty feet diameter would each have displaced 4189 cubic feet, making in all 16,756 cubic feet, weighing 1256 pounds; so that whatever less than this his globes and appendages weighed would have been the ascensive power of his aërial machinery. Now, the surface of one of these copper globes would contain 1256 square feet, which, at the common pressure of the atmosphere on the surface of the earth, would have an external pressure of 2,712,960 pounds—a force sufficiently great to have crushed it, had it been made light enough to be raised by atmospheric buoyancy. Had Lana known the exact pressure and specific gravity of the air, his mathematical knowledge would have at once suggested to his mind the



GUZMAN'S MACHINE.



BESNIER'S EXPERIMENT.

impracticability of his machinery. Notwithstanding that these difficulties presented themselves to Lana's plan, there were not wanting advocates of its efficiency. A few years ago it was attempted in Paris. In this experiment the balloon was composed of silk, the vacuum being formed by forcing the balloon open by the aid of light framework arranged with ropes and pulleys fixed in the inside of it.

In the "Journal des Savans" of the 12th of September, 1678, an account is given of one Besnier, a locksmith of Sable, in France, who succeeded in flying. His wings consisted of four rectangular surfaces, one at the end of each of two rods passing over the shoulders of him who used them. The inventor did not pretend that he could rise from the earth or sustain himself long in the air with them, from the inability to give his apparatus the required power and rapidity; but he availed himself of their aid in progressively raising himself from one height to another until he reached the top of a house, from the roof of which he passed over the neighboring houses. By thus having an elevated position he could cross a river of considerable breadth, or any other obstacle. His first pair of wings were purchased by a Mr. Baldwin, of Guibre, who, it is said, used them with remarkable success. One John Babtiste Dante also framed a pair of wings with which it is stated he could fly; he finally ended his career by breaking his thigh.

In pursuing the history of our subject, we next find a letter dated Lisbon, the 10th of February, 1709, which was published soon after in some of the scientific journals of Paris, containing also the copy of an address presented to the king of Portugal, by a friar called Bartholomew Laurence de Gusman. In this letter the petitioner represents himself as having invented a flying machine capable of carrying passengers and navigating through the air very swiftly. He also claims that he is the sole possessor of the invention, desiring a prohibition against all and every person from constructing a similar machine, under a severe penalty. Upon this the king issued the following order in his favor:

"Agreeably to the advice of my council, I order the pain of death against the transgressor. And in order to encourage the suppliant to apply himself with zeal toward improving the machine which is capable of producing the effects mentioned by him, I also grant unto him the first professorship of mathematics in my university of Coimbra, and the first vacancy in my college of Barcelona, with the annual pension of 600,000 reis during his life.

"The 17th day of April, 1709."

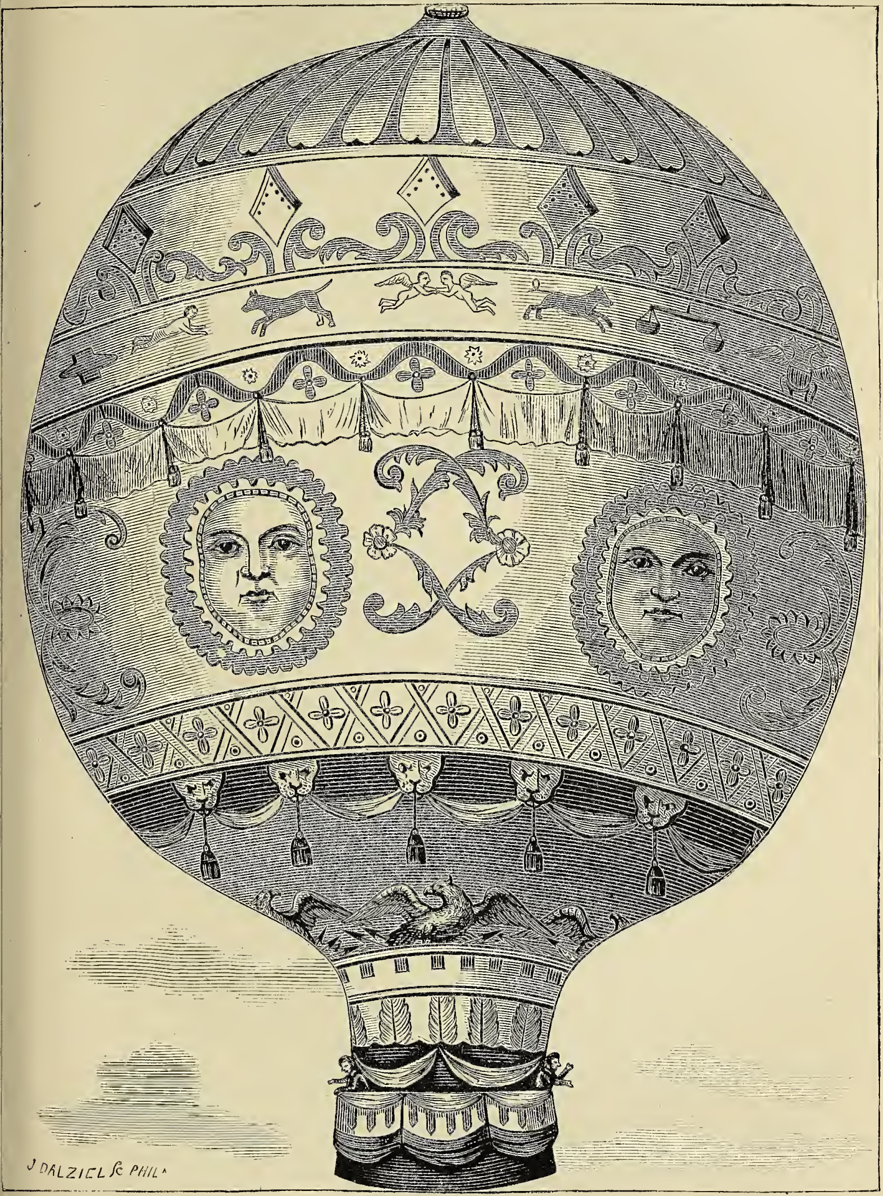
The drawing of this machine somewhat resembles a bird. The propulsive effect was to be produced by the wind, which was to pass through several tubes and swell a sail something in the shape of a parachute. In the absence of the wind, it was to be produced by a pair of bellows, assisted by two powerful magnets and several pieces

of amber, which were to pull upward, with other contrivances equally vague and absurd. It appears, however, that this applicant for the king's favor was nothing more than a pretender without ingenuity, for the whole design, as near as it can be traced, is merely a modified form of Archytas' flying bird. In many of the writer's descriptions a great deal of ingenuity and mechanical skill is manifested, but in the above we have nothing but that never-to-be-forgotten notion of making a thing lift itself up. And even at this day we have persons who have erected pumps to pump up water to a head race for the purpose of driving mill machinery, which is about equal to De Gusman's idea of supplying wind by bellows to propel his flying chariot. Of this class of persons are the *wanderers* after perpetual motion.

De Bourgois, in his "Recherches sur l'Art de Voler," says that in the above account the name of De Gusman is wrongly annexed to Bartholomew Laurence, and that they were distinct persons. He tells us that it was Bartholomew Laurence who presented the petition to the king, and of De Gusman he relates the following history: In the year 1736, De Gusman made a wicker basket of about seven or eight feet in diameter, covered with paper, which basket elevated itself as high as the tower of Lisbon. This author says that he learned this from a very creditable person who witnessed the experiment, but that, for better confirmation of it, he wrote to a distinguished merchant of Lisbon, who answered him that it was true, and that many persons still remembered it, though they attributed it to witchcraft.

Joseph Gallien published a book in 1755, at Avignon, entitled "L'Art de Naviger dans les Airs," in which he asserts that a bag of cloth or leather filled with an air lighter than that of atmosphere might be used with perfect security for the purpose of aërial voyages. Had Gallien been acquainted with hydrogen gas, and the means of its production, the honor of the discovery of aërostatic machinery would no doubt have fallen to him. It may be possible that De Gusman's machine was nothing more than a paper vessel kept distended by a wicker frame, and made to rise by heating the air within it, which might have been accomplished without having fire attached to it when it ascended. By passing it in very hot and suddenly letting it go it would rise some distance. This idea is strengthened from the mention that is made of its rising up two hundred feet and immediately coming down again. However, as De Gusman never made known the principle by which his machine was elevated, the merit of discovery cannot be awarded to him.

A great many experiments were now put in operation to solve the problem of atmospheric buoyancy. After it was really solved, a number of persons contended that they were the first to make the discovery. We shall, therefore, refer to the most noted authors on this subject who wrote immediately after the solution of the problem.




MONTGOLFIER'S BALLOON.

## CHAPTER III.

Discovery of aërostatic machines—Experiments—Academy of Arts and Sciences of Paris taking it in hand—Excitement of the French people about it—A sheep, cock and duck the first aërial adventurers—De Rozier and Marquis de Arlandes ascend with a fire balloon—Particulars of their voyage—Procès verbal—Experiment of Rittenhouse and Hopkinson—Experiments with inflammable air—Cavallo on the discovery of the hydrogen balloon—Experiments at Lyons with a mammoth fire balloon—Experiments at Milan.

AFTER progressive researches and repeated experiments during the lapse of more than twenty centuries, the secret of aërial navigation was at length discovered in the year 1782 in France. When we consider the attention that was paid to the subject during its progress through so many years by the most learned men, we may reasonably expect that much more will be done to improve its present condition, and make it what it can be and ought to be made—the most expeditious, easy and pleasant mode of travelling that the human family is capable of enjoying.

After the elasticity of air was discovered, and its real weight and nature ascertained, it would seem that no great difficulty lay in the way of making a successful experiment. But this, like almost every other important discovery, was in the end attained by indirect means, rather than by purely preconsidered and tried experiments on the subject. It may be that Bacon's and Lana's notions of the atmosphere's *surface* suggested the idea of the cloud-and-smoke principle. However, as we have no information that the Montgolfiers had particularly devoted any of their pursuits to the discovery of aërostatics, it does rather appear that the idea was spontaneously suggested.

The natural ascent of smoke and clouds, it appears, first inspired the two brothers Stephen and Joseph Montgolfier to make their aërostatic experiment. Stephen, the younger of the two brothers, concluded in his mind that if a light paper bag were to be made and filled with *cloud* or *smoke*, either of these substances, from its natural inclination to rise, would carry the bag with it in an upward direction. Accordingly, a light paper bag of an oblong shape was made, of a capacity of about forty cubic feet. With this they made their first experiment in a private manner in their own chamber, at Avignon,

about the middle of November, 1782. The lower part of the bag had an orifice to which they applied burning paper, upon which it began to distend itself, and in a few minutes sustained itself by being held at its lower part. On being released, it ascended to the ceiling of the chamber, where it remained a few moments, much to the joy and astonishment of its projectors. Moved on by this pleasing experiment, they next tried it in the open air. Here, again, after it was inflated and released, it ascended, reaching a height of about seventy feet.

Encouraged by this success, the experiment was next to be made on a larger scale. For this purpose an envelope of a capacity of about 600 cubic feet, and of a spherical shape, was made. Upon trial, this experiment far exceeded their most sanguine expectations. This balloon (for this was made after the shape of a *balloon*, "a large, round, short-necked vessel used in chemistry," and hence the name of balloon for aërial ships), after being inflated in the same manner as the former, became so strong that it broke the strings by which it was to be retained a certain distance above the earth, ascended to a height of about six or seven hundred feet, and alighted soon after upon the adjoining ground.

Finding, upon these trials, that as they enlarged their machines (the balloons), they succeeded better, they concluded to build one of thirty-five feet in diameter. Such a balloon was accordingly constructed, and the 3d day of April, 1783, was fixed on to make the experiment. When the appointed day came, the wind was so violent that it was thought most prudent to defer it until the 25th of the same month. This proving a more favorable day, the trial came off handsomely, and with unbounded applause from those who were in attendance. The balloon, after being filled and released, rose suddenly into the air until it reached a height of at least 1000 feet, and fell to the ground at the distance of three-quarters of a mile from the place where it had ascended. It was now concluded by the Montgolfiers to make a public experiment with this last-constructed balloon on the 5th of June following. Accordingly, invitations were extended; and, as might naturally be expected, a great concourse of spectators assembled to witness the novel and extraordinary sight. This balloon, being of a spherical form, thirty-five feet in diameter, had a capacity of nearly 23,000 cubic feet. It was inflated over a pit or well in which were burned *chopped straw and wool*, over which the lower orifice of the balloon was placed by swinging it from a cross rope fixed up for the purpose. When it was fully inflated with heated air, it was found to have an ascending power of 500 pounds. As it displayed its huge dimensions, the spectators gave vent to loud exclamations and shouts of applause. In a few moments after it was filled it was released from its fastenings, and ascended majestically amidst the most deafening shouts of approbation. It rose to the height of six or seven thousand feet, and fell to the ground at the distance of a mile and a half from its point of departure.

After this demonstration, the wonderful invention was heralded to

every part of Europe with a rapidity that its importance had naturally inspired. The particulars, as stated in one of the journals of the day, are as follows: "On Thursday, the 5th of June, 1783, the States of Vivarais being assembled at Annonay, Messrs. Montgolfiers invited them to see their new aërostatic experiment. An immense bag of linen lined with paper, and of a shape nearly spherical, had its aperture, which was on its inferior part, attached to a frame of about sixteen feet surface, upon which it lay flaccid like an empty linen bag. When this machine was inflated, it measured 117 English feet in circumference; its capacity was equal to about 23,000 cubic feet, and it had been calculated that when filled with the vapor proper for the experiment it would have lifted up about 490 pounds, besides its own weight, which, together with that of the wooden frame, was equal to 500 pounds, and this calculation was found to be pretty correct by experience. The bag was composed of several parts, which were joined together by means of buttons and holes, and it is said that two men were sufficient to prepare and fill it, though eight men were required to prevent its ascension when filled."

Other accounts give a still more glowing description of this wonderful experiment; but as the one we quote seems to be written with soberness and accuracy, we prefer it to any of the rest. The conflicting opinions in regard to the possibility of such a thing, the doubts of others, with an ardent degree of credulity manifested by those who had either seen or positively heard of its having been done before, all combined to give the occasion an extraordinary character.

This occasion dated an epoch in the history of aëronautic science. The subject was now taken up with renewed vigor. Various claims were set up for its discovery. Cavallo intimated that he had made the first air balloons, but concedes the right of practical application to the Montgolfiers. He says, in speaking of this subject: "The weight and elasticity of the air were well known to the ancient philosophers, as may be deduced from several passages in their works. Borrelli relates an experiment of a Florentine, called Candido Buono, which shows that air rarefied by heat becomes lighter, and ascends amid the colder air. This easy, and at the same time satisfactory, experiment consists in bringing a red-hot iron under one of the scales of a balance when that instrument hangs in equilibrio; for as soon as the red-hot iron is brought under one of the scales, the air, heated and rarefied by it, will ascend, and will impel the said scale upward, the opposite scale descending as if a weight were put to it."

Whatever knowledge may have existed on this point, it is evident from the history of the case that the Montgolfiers did not make the discovery on that account; and if they even had, it would not detract from the merit of their discovery. It would seem that they rather based the idea of success on having discovered how to make artificial clouds, supposing they were constituted of a vapor or gas specifically lighter than atmosphere. This doctrine was even maintained by the

advocates of the Montgolfierian system after the hydrogen balloon was introduced.

Soon after the experiment had been made at Annonay, Stephen Montgolfier arrived in Paris. He was immediately invited to attend the sitting of the Royal Academy of Sciences, and by that body requested to repeat his experiment at their expense. He cheerfully accepted the proposition, and soon constructed a large balloon of an elliptical shape, seventy-two feet high and forty-one feet in diameter. When completed, it was found to weigh 1000 pounds. It was finished and decorated in a most magnificent style, elegantly ornamented over its outer surface with beautiful and appropriate designs. At a preliminary experiment it raised eight men from the ground. On the 12th of September, 1783, the day appointed for its exhibition before the members of the Royal Academy, it ascended with a load of from four to five hundred pounds, but owing to a violent gust of wind at the time, it was damaged in the ascent, which prevented it from attaining a great height. Upon its descent the balloon was found to be so much damaged that a new one, of nearly the same dimensions, was ordered to be made. To this was added a basket of wicker-work. It was then inflated, in the presence of the king and royal family, at Versailles, and a sheep, a cock and a duck were placed in the basket. With these three living animals as its passengers, it was launched into the upper air, when it ascended to the height of about 1500 feet. Owing to a similar accident that befell the other, it did not rise so high as it otherwise would. The animals, however, landed safely with it at a distance of 10,000 feet from the place of ascent.

This was the first experiment in which any living creature ascended with an aërostatic machine. Another was now constructed which was seventy-four feet high and forty-eight feet in diameter. With this large balloon, M. Pilâtre de Rozier volunteered to make an aërial voyage. This machine had an opening at the bottom end of about fifteen feet in diameter. Around this opening was arranged and fastened a gallery of wicker-work three feet broad, and around the outer edge of this was a balustrade of the same material three feet high, and around the lower circumference of the balloon, and immediately above the gallery platform, port-holes were worked in it for the purpose of introducing fuel. From around the lower aperture of the balloon chains were suspended, to which was fastened an iron brasier, intended for the fire-place, on which the aëronaut could easily introduce his fuel from the port-holes as necessity required it. With this machine M. Pilatre de Rozier made several ascents to the height of two or three hundred feet, while it was fastened by ropes of that length. On the 21st of November he, in company with the marquis d'Arlandes, concluded to make an aërial voyage. Accordingly, the balloon was inflated and the gallery supplied with fuel, whereon M. Pilâtre de Rozier and the marquis d'Arlandes stationed themselves on opposite sides of the gallery. At a given signal, the balloon was released from its

THE FIRST ASCENSION.

moorings and left free in the air. It rose majestically, amidst the shouts and applause of a delighted multitude, until it attained a height of 3000 feet. The whole machine, with fuel and passengers, weighed 1600 pounds. The parties remained in the air twenty-five minutes, and encountered various currents of wind. During this voyage they were several times in imminent danger by the balloon taking fire. The marquis became greatly agitated at this, and desired to make a precipitate descent, which might have ended the adventure with serious consequences. But the coolness and intrepidity of M. Pilâtre de Rozier prevented them from incurring this danger, as he had provided himself with a sponge and water for the emergency, with which he very deliberately extinguished the fire, which enabled them to remain in the atmosphere some time longer. They raised and lowered themselves frequently during this excursion by regulating the fire in the brasier, and finally landed in safety five miles from where they started, after having sailed over a great portion of Paris. Previous to this voyage M. Pilâtre de Rozier ascended several hundred feet high, in company with M. Girond de Vilette. We will here give the original documentary account of this most interesting aërial voyage, which, it will be seen, was witnessed by Benjamin Franklin:

"*Procès Verbal.*—To-day, November 21, 1783, at the château de la Muette, took place an experiment with the aërostatic machine of M. de Montgolfier. The sky was partly clouded; wind north-west. At eight minutes after noon a mortar gave notice that the machine was about to be filled. In eight minutes, notwithstanding the wind, it was ready to set off, the marquis d'Arlandes and M. Pilâtre de Rozier being in the car. It was at first intended to retain the machine a while with ropes, to judge what weight it would bear and see that all was right. But the wind prevented it rising vertically, and directed it toward one of the garden walls; the ropes made several rents in it, one being six feet long. It was brought down again, and in two hours was set right. Having been filled again, it set off at fifty-four minutes past one, carrying the same persons. It rose in the most majestic manner; and when it was about 270 feet high, the intrepid voyagers took off their hats and saluted the spectators. No one could help feeling a mingled sentiment of fear and admiration. The voyagers were soon undistinguishable; but the machine, hovering upon the horizon, and displaying the most beautiful figure, rose at least 3000 feet high, and remained visible all the time. It crossed the Seine, below the barrier of La Conference, and passing thence between the Ecole Militaire and the Hôtel des Invalides, was in view of all Paris. The voyagers, satisfied with their experiment, and not wishing to travel farther, agreed to descend; but seeing that the wind was carrying them upon the houses of the Rue de Seve, Faub. St. Germain, they preserved their presence of mind, increased the fire, and continued their course through the air till they crossed Paris. They then descended quietly on the plain beyond the New Boulevard, opposite the mill of Croulebarbe, without having felt

the slightest inconvenience, and having in the car two-thirds of their fuel. They could then, if they had wished, have gone three times as far as they did go, which was 5000 *toises*, done in from twenty to twenty-five minutes. The machine was seventy feet high and forty-six feet in diameter; it contained 60,000 cubic feet, and carried a weight of from 1600 to 1700 pounds. Given at the château of La Muette, at five in the afternoon. Signed, Duc de Polignac, Duc de Guisnes, Compte de Polastron, Compte de Vaudreuil, D'Hunaud, Benjamin Franklin, Faujus de St. Fond, Delisle, Leroy, of the Academy of Sciences."

The following is an extract from a letter written by the marquis d'Arlandes to M. de St. Fond concerning this first aërial voyage, dated November 28, 1783: "We set off at fifty-four minutes past one. The balloon was so placed that M. Rozier was on the west and I on the east. The machine, says the public, rose with majesty. I think few of them saw that at the moment when it passed the hedge it made a half turn, and we changed our positions, which, thus altered, we retained to the end. I was astonished at the smallness of the noise or motion occasioned by our departure among the spectators; I thought they might be astonished and frightened, and might stand in need of encouragement, so I waved my arm, with little success. I then drew out and shook my handkerchief, and immediately perceived a great movement in the yard. It seemed as if the spectators all formed one mass, which rushed by an involuntary motion toward the wall, which it seemed to consider as the only obstacle between us. At this moment M. de Rozier called out, 'You are doing nothing, and we do not rise.' I begged his pardon, took some straw, moved the fire and turned again quickly; but I could not find La Muette. In astonishment, I followed the river with my eye, and at last found where the Oise joined it. Here, then, was Conflans; and naming the principal bends of the river by the places nearest to them, I repeated Poissy, St. Germain, St. Denis, Seve; then I am still at Poissy or Chaillot. Accordingly, looking down through the car, I saw the Visitation de Chaillot. M. Pilâtre said to me at this moment, 'Here is the river, and we are descending.' 'Well, my friend,' said I, 'more fire;' and we set to work. But instead of crossing the river, as our course toward the Invalides seemed to indicate, we went along the Ile des Cygnes, entered the principal bed again, and went up the stream till we were above the barrier La Conference. I said to my brave associate, 'Here is a river which is very difficult to cross.' 'I think so,' said he; 'you are doing nothing.' 'I am not so strong as you,' I answered; 'and we are well as we are.' I stirred the fire, and seized a bundle of straw, which, being too much pressed, did not light well. I shook it over the flame, and the instant after I felt as if I had been seized under the arms, and said to my friend, 'We are rising now, however.' 'Yes, we are rising,' he answered, coming from the interior, where he had been seeing all was right. At this moment I heard a noise high up in the balloon, which made me fear it had burst. I

looked up, and saw nothing; but as I had my eyes fixed on the machine, I felt a shock—the first I had experienced. The shock was upward, and I cried out, 'What are you doing? are you dancing?' 'I am not stirring.' 'So much the better,' I said; 'this must be a new current, which will, I hope, take us off the river.' Accordingly, I turned to see where we were, and found myself between the École Militaire and the Invalides, which we had passed by about 400 toises. M. Pilâtre said, 'We are in the plain.' 'Yes,' I said, 'we are getting on.' 'Let us set to work,' he replied. I heard a new noise in the machine, which I thought came from the breaking of a cord. I looked in, and saw that the southern part was full of round holes, several of them large. I said, 'We must get down.' 'Why?' 'Look!' said I. At the same time I took my sponge and easily extinguished the fire, which was enlarging such of the holes as I could reach; but on trying if the balloon was fast to the lower circle, I found it easily came off. I repeated to my companion, 'We must descend.' He looked around him, and said, 'We are over Paris.' Having looked to the safety of the cords, I said, 'We can cross Paris.' We were now coming near the roofs; we raised the fire, and rose again with great ease. I looked under me, and saw the Missions Etrangères, and it seemed as if we were going toward the towers of St. Sulpice, which I could see. Raising ourselves, a current turned us south. I saw on my left a wood which I thought was the Luxembourg. We passed the Boulevard, and I called out, 'Pied à terre.' We stopped the fire; but the brave Pilatre, who did not lose his self-possession, thought we were coming on mills, and warned me. We alighted at the Butte aux Cailles, between the mill Des Merveilles and the Moulin Vieux. The moment we touched land I held by the car with my two hands; I felt the balloon press my head lightly. I pushed it off, and leaped out. Turning toward the balloon, which I expected to find full, to my great astonishment it was perfectly empty and flattened."

These are the first aërial voyages that were ever made by human beings of which we have any well-authenticated proof, and to these all true historians must point as the first practical and fully successful experiments in navigating the air.

The Montgolfiers were natives of Annonay, and were the sons of a wealthy paper manufacturer who had retired from business and left it in their hands. From the history that is afforded of them, it appears that they were both attached to the study of mathematical science; but it seems they were not exactly acquainted with the true nature of the substance that caused the ascent of their balloons. They attributed the ascending power to a peculiar kind of gas which was emitted by the combustion of chopped straw and wool mixed together. This, however, does not in the least detract from the merit of their discovery; and so the learned men of that day thought, for at the next meeting, after their experiment, of the Royal Academy of Arts and Sciences of Paris, that eminent body voted Stephen Montgolfier a gold

medal, in honor of having made the most important discovery of that period.

That the Montgolfiers did not exactly understand the cause or nature of the material that gave ascensive power to their balloons is evidenced by their affidavit which communicated the discovery to the Royal Academy. In this the effect of the balloon's ascension is not attributed to the rarefied state of the air which filled it, but to a peculiar gas evolved by the burning of straw and wool, which they termed "certain materials." It was, for want of a better name, termed *Montgolfier's gas*, and led even the members of the Academy to believe for a while that a new kind of gas, other than hydrogen and lighter than common air, had been discovered. A certificate to this effect was signed by the dukes of Polignac and de Guines, the counts de Polarton and de Vaudreuil, Dr. Benjamin Franklin, and Messrs. Faujus, Delisle and Leroy, of the Academy of Arts and Sciences. Dr. Franklin was then in Paris, and had been elected to a membership of that noted institution.

During the latter part of the same year, Dr. Rittenhouse and Mr. Hopkinson made some experiments in the city of Philadelphia by connecting four balloons together, which were inflated with hydrogen gas. An individual ascended with these to the height of several hundred feet; but taking alarm, he was induced to cut a hole in one of them, which caused him to descend.

Inflammable air, or hydrogen gas, which is its proper name, was discovered as early as the year 1766. It was even known to exist long before that time by miners of coal. Its fatal effects have often been experienced by that class of men. But its properties were first made known in the year just named by Mr. Cavendish, as will be seen by reference to the Philosophical Transactions of that period.

Tiberius Cavallo says: "Soon after this discovery of Mr. Cavendish, it occurred to the ingenious Dr. Black, of Edinburgh, that a vessel might be made which, when filled with inflammable air, might ascend into the atmosphere in consequence of its being altogether lighter than an equal bulk of common air." This idea of the doctor had been frequently mentioned, but he himself wrote a candid account of it to Dr. James Lind, physician at Windsor. The following is a part of the letter:

"EDINBURGH, Nov. 13, 1784.

"DEAR SIR: The person who first discovered with exactness the specific gravity of inflammable air was, as far as I know, Mr. Cavendish. I never heard of any experiments made with that intention before his appeared in the Philosophical Transactions for the year 1766. It had been my constant practice before to show every year in what manner it burns when pure and unmixed with air, and how it exploded when air is mixed with it before it is fired, but Mr. Cavendish made a variety of such mixtures by rule and measure, and describes in the same paper the manner in which they severally exploded. As soon as

THE MONTGOLFIER BROTHERS.

BLANCHARD.

I read the above paper it occurred to me, as an obvious consequence of Mr. Cavendish's discovery, that if a sufficiently thin and light bladder were filled with inflammable air, the bladder and the air in it would necessarily form a mass lighter than the same bulk of atmospheric air, and which would rise in it; this I mentioned to some of my friends, and in my lectures the next time I had occasion to speak of inflammable air, which was either in the year 1767 or 1768; and as I thought it would be an amusing experiment for the students, I applied to Dr. Munro, dissector, to prepare for me the allantois of a calf. The allantois was prepared, but not until after some time had passed, and when I was engaged with another part of my course, and did not choose to interrupt the business then going on, so I dropped the experiment for that year, and in the subsequent years I only mentioned the matter as an obvious and self-evident thing, from Mr. Cavendish's discovery; but finding generally some difficulty in providing an allantois at the proper time, I never made the experiment, which I considered as merely amusing. About two months ago I was informed by a gentleman in the South of Ireland that he had tried it, and that it succeeds perfectly well."

These circumstances are related by some writers to show that the principle of raising aërostatic machines had been discovered before the experiment was made by the brothers Montgolfier. Tiberius Cavallo introduces this letter of Dr. Cavendish's in an article wherein he himself claims to be the first person who succeeded in raising balloons. He says: "The possibility of constructing a vessel which, when filled with inflammable air, would ascend into the atmosphere, had occurred to me when I first began to study the subject of air and other permanently elastic fluids, which was about eight years ago; but early in the year 1782 I actually attempted to perform this experiment, and the only success I had was to let soap-balls filled with inflammable air ascend by themselves rapidly into the atmosphere, which was perhaps the first sort of inflammable air balloons ever made. I failed in several other attempts of the like nature, and at last, being tired with the expenses and loss of time, I deferred to some other time the prosecuting of these experiments, and contented myself with giving an account of what I had done to the Royal Society, which was read at a public meeting of the society on the 20th of June, 1782."

Although Mr. Cavallo concedes the right of discovering the aërostatic machine which first proved successful to the Montgolfiers, it is but due to his ingenuity and ability in philosophical pursuits to give his ideas in full upon this subject. The following is a copy of the paper presented to the society by Mr. Cavallo:

"It has been commonly believed that common air would not pervade the pores of paper such as is used for common printing or writing; and that paper is permeable to water, and not to air, has been alleged by some persons as an instance tending to prove that some fluids have

the property of passing through certain substances and others have not, although the particles of the former are of a grosser, heavier or more of a tenacious nature toward each other.

"Admitting, according to the common notion, this impermeability of paper to common air, and presuming that it was impervious to other permanently elastic fluids also, I determined to make use of paper for an experiment, which, though repeatedly attempted with other substances, had never succeeded. The experiment was to construct a vessel or a bag which, when inflated with inflammable air, might be lighter than an equal bulk of common air, and consequently ascend like smoke into the atmosphere, it being well known that inflammable air is specifically lighter than common air.

"The weight of inflammable air, the mean weight of atmospheric air and the weight of substances of which the vessels are to be formed being ascertained, it is easy then to determine by calculation the dimensions of a vessel which, when filled with inflammable air, might be lighter than an equal bulk of atmospheric air. In this manner, and for the above-mentioned purpose, I tried bladders the thinnest and largest that could be procured. Some of them were cleaned with great care, removing from them all the superfluous membranes and matter that could be possibly scraped off; but notwithstanding all these precautions, the lightest and largest of these bladders being gauged and the requisite calculations being made, it was found that when filled with inflammable air it would be at least ten grains heavier than an equal bulk of common air, and consequently it would descend instead of ascending in that element. Some swimming bladders of fishes were also found too heavy for the experiment, nor could I even succeed in making durable light balls by blowing inflammable air into a thick solution of gums, thick varnishes and oil paint. In short, soap-balls inflated with inflammable air were the only things of this sort that would ascend into the atmosphere; but as they were very brittle and altogether untractable, they do not seem applicable to any philosophical purpose."

Thus it is seen that in the progress of over 2000 years this science was gradually built up, each succeeding generation adding to it the ideas and recommendations of its most ingenious artists. As an obvious truth, it naturally inspired the scientists of all ages to experiment with regard to the feasibility of adapting it to human convenience. As an acknowledged science and practicable art, it is yet destined to open to the civilized world a grand and expansive field of happiness. Those who contributed to its discovery deserve the attention of the historian, because their perseverance and indefatigable efforts devoted to its development are calculated to keep alive the energy of those who shall succeed them in endeavoring to improve its usefulness.

Although Mr. Gallien, in his book published in 1755, asserts in theory the very thing that was practically demonstrated by the Mont-

golfiers in 1782, and Tiberius Cavallo more than theorized the subject by inflating soap-bubbles, still, it required much more than all these intimations and incomplete experiments to demonstrate to the world that the atmosphere was really navigable to human beings. Tiberius Cavallo did in reality approach nearer to a final discovery than any of his predecessors, but from his own words he makes it appear that little beyond the partial success of his soap-bubbles was attained in his investigations. The necessary stimulus—realization of the theory, such as the experiment at Annonay—yet wanting, would have left the subject to slumber with the mysteries unrevealed had it depended on his experiment alone—at least for a time to come.

The Royal Academy had the same inducements from a merely philosophical point of view to institute experiments with regard to the ascent of bodies in the air, upon Cavallo's communications and those of Dr. Black, that they had on the information of the Montgolfiers' discovery. In short, the merit of any discovery properly belongs to the actual inventor—to him who first realizes the idea by putting it in practical operation, just as the Montgolfiers did with their balloons.

After the decisive experiment had been made by the aërial voyage of M. Pilâtre de Rozier and the marquis d'Arlandes over the city of Paris, and in sight of all the people of that modern Athens, it naturally gave an impulse to the subject that operated more favorably on its progress and improvement than any mere theory or simple experiments could have given it for ages. It was the *experimentum crucis* of aëronautic science. The news of it spread like wildfire through every civilized nation on the earth. America, not behind the rest, and with its Rittenhouse and Hopkinson, distinguished our nation, even on that subject, for the genius and boldness of its people.

Paris did not long remain alone the theatre of aëronautic experiments. In the following year a balloon of most extraordinary size was constructed in the city of Lyons. It was 130 feet high and 105 feet in diameter. It lifted up over eighteen tons when the air was highly rarefied in it. On the 19th of January, 1784, an experiment was made with it. After the preliminary arrangements of preparing a fire-place over which to inflate it, and a frame on which to lay it, the inflation was completed in the short space of seventeen minutes. Seven aëronauts then took their station on and around the gallery of the balloon. Everything being now adjusted so as to keep this huge machine in proper trim, the rarefaction of the air within it being at such a pitch as to give it a tremendous ascending power, it was thus suffered to waft itself and passengers into the serene atmosphere above.

The effect of the ascension, as given by the accounts at the time, was astonishing in the extreme. The intense curiosity of the vast concourse of people present seemed at first completely paralyzed by the grandeur of its ascent; but, soon after, they broke out in the most intense and tumultuous shouting. In seventeen minutes the balloon rose 3500

feet high, which was ascertained by instruments expressly provided for the occasion.

Unfortunately for this magnificent machine, it was made of too frail a quality for so large a balloon, which caused it to give way on one side when it was at its greatest height, making a rent of at least fifty feet. This caused the enclosed air to cool very suddenly, which brought the whole concern down with considerable rapidity. The passengers, however, all landed safely, having received not even the slightest injury from the accident.

In the month of February of the same year a balloon was constructed at Milan. This was only sixty-eight feet in diameter. Three Italian gentlemen ascended with it, and made a very interesting voyage. They remained in the atmosphere for a considerable length of time, and managed to lower and raise themselves at pleasure by regulating the fire by which they kept up the rarefaction of the air in the balloon. They were eminently successful in the whole adventure, which inspired a degree of confidence in that quarter, in regard to the management and safety of aërial travelling, that acquired for the subject a fresh spirit of improvement.

Having thus followed out the most important experiments and adventures made with fire balloons on the Montgolfierian principle, we will now go back a year or two to investigate the introduction of and experiments with the hydrogen balloon.

# CHAPTER IV.

Introduction of the hydrogen balloon under the auspices of members of the Academy of Arts and Sciences—The inflation—Torch-light procession with it to the Champs de Mars—Successful termination.

AFTER the subject had been fairly tested in the presence of all classes of people, and the news clearly brought before the learned institutions of the world, it naturally inspired the members of the French Academy to take up anew the experiments of Cavallo and the suggestions of Dr. Black. The certificate presented to the Academy by the States of Vivarais stated that the Montgolfiers' balloon was filled with a gas half as heavy as common air. Now, as it was known at that time that hydrogen gas was not more than one-eighth or one-tenth as heavy as common air, they supposed that the Montgolfiers had discovered a new kind of gas. From the large quantities used in their experiments, and the very short time it took them to generate it, it was evident that it could not be hydrogen. This, together with the great difference of specific gravity of the two gases, brought them to the conclusion to make an experiment with the hydrogen.

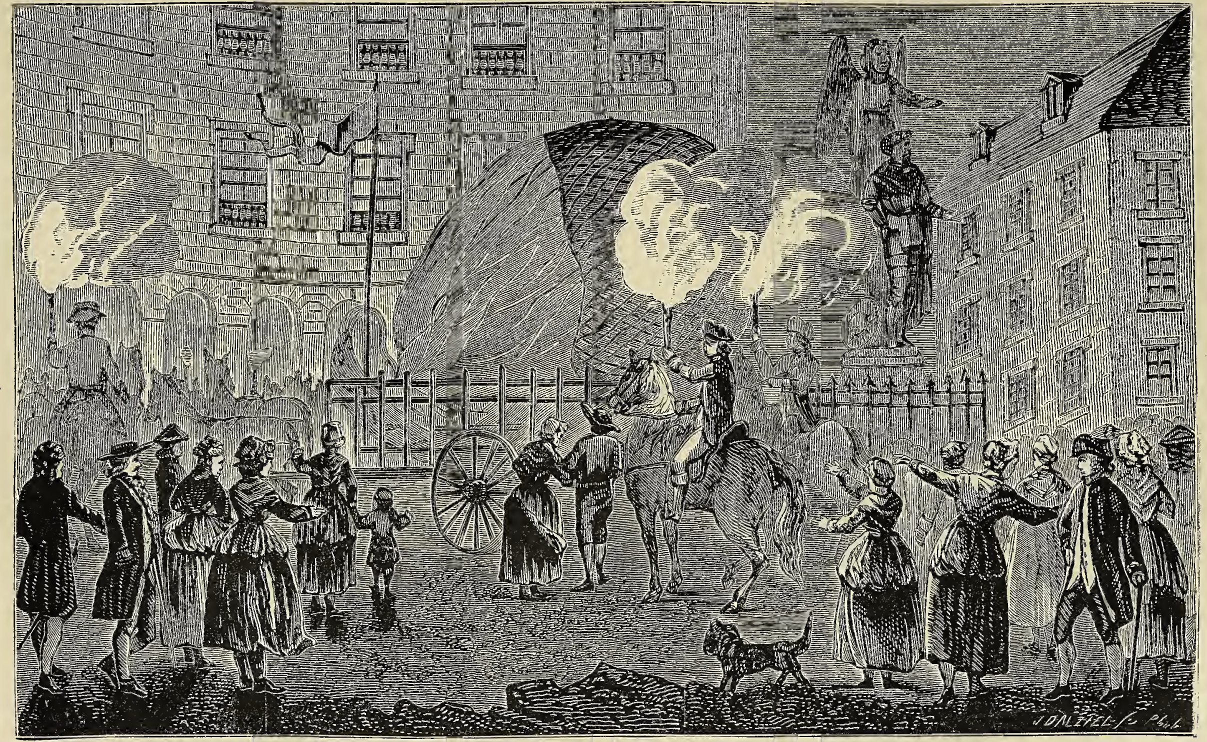
When we consider the many and fruitless attempts that had been made by a number of ingenious men, in various parts of Europe, to contrive a machine or vessel that would be impervious to hydrogen gas, and at the same time light enough to ascend when filled with it, we can duly appreciate the result of this first experiment. A subscription to defray the expenses incident to the necessary arrangements was opened by M. Faujus de Saint Fond. Persons of all classes and ranks, on being apprised of the design, eagerly sought an opportunity to put down their names. With an avidity of feeling adequate to the interest already inspired to promote the object, the money necessary to accomplish a full and complete trial was immediately subscribed. This preliminary disposition of the people in regard to furthering an object which promised to be of vast importance to the civilized world reflects honor on the French nation for their liberality of spirit and desire to promote scientific objects.

The Messrs. Roberts (brothers) were appointed to construct the machine, and M. Charles, professor of experimental philosophy, was appointed to superintend the whole affair. Although the reader will

learn that under these preliminary arrangements they surmounted every obstacle and accomplished the object of their design, still, they had nothing more to be governed by than was known to Gallien, Dr. Black, Cavallo and others who preceded them. It might be inquired, How could they be more successful now than then, if they had nothing more obvious to direct them in the present attempt? Why, because a new life had been given to the inventive genius. The experiment of the Montgolfiers had really proven that aërostatic machines could be made and raised. This fired the ingenuity of these men. They had not the question to settle, when their machine was made, whether it would rise. It had only to be made and filled with a gas (hydrogen) which they knew to be lighter, and consequently better adapted to the object in view, than that of their predecessors. To make a bag that would retain the gas was the problem to be solved, and for the accomplishment of this as it was done they deserve great honor. Of such a nature must be the stimulus that is yet to give the art a valuable feature. We know that the air is navigable. We know that it is in the elements of philosophy that balloons can be made to travel in any direction. And, like the committee appointed to perfect the first step, we must apply ourselves with zeal and energy to promote the second.

They constructed a silken bag from lustering silk, about thirteen feet in diameter, and of a globular shape. The next step was to make this bag or balloon impervious to the gas. To effect this, it was covered with a varnish composed of gum elastic dissolved in spirits of turpentine. The balloon had but one aperture, like the neck of a bottle, into which was fastened a stopcock, for the convenience of introducing and stopping off the gas. The whole machine, when completed, weighed twenty-five pounds.

On the 23d of August, 1783, the balloon being completed, the next thing to be done was to make arrangements for the inflation, and the appointment of a day on which to make the final experiment. These were matters not to be regarded lightly at that day. Members of the most celebrated institution of the age had ventured their talents and ingenuity upon the result. To generate so large a quantity of hydrogen gas at that period was a very difficult matter, and on this account a full description of the manner in which it was conducted should be here given. The 27th of the month was the day appointed for the grand exhibition. But in order to have ample time for alterations, and refixing any part of the apparatus that might not answer the purpose, they commenced the inflation on the 23d. The balloon was suspended from a rope, which was fastened at both ends to poles planted some distance apart for that purpose. The top of the balloon had a sort of button worked in it, to which was fastened the rope, by which it was hanging freely over the inflating apparatus. This apparatus consisted of a series of trays, somewhat resembling a case of drawers, each drawer being lined with sheet lead, and all of them communicating to a common main pipe, from which proceeded a hose, or tube,



TORCHLIGHT PROCESSION WITH CHARLES' BALLOON.

made of the same material as that of the balloon. This hose communicated to the stopcock of the balloon, which made the arrangement of communication complete. The materials for generating the hydrogen gas were then placed in these cases, and the process of inflation was carried on for several hours, with but very poor success. More gas was wasted than entered the balloon. After having thus labored, with little success, until two o'clock in the afternoon, they concluded to remove this apparatus and substitute another. Accordingly, they next tried a common cask, which was set up on one of its ends; in the upper end were bored two holes, one of which corresponded to the tube through which the gas was to be conducted into the balloon; the other hole was intended for the introduction of the iron filings and the oil of vitriol. The process of inflation was next commenced with this new contrivance, which soon promised better success than the former. It will be observed that they had not, in this apparatus, the condensing tub filled with water for the gas to pass through, as we have in the present mode of inflating balloons. This rendered the inflation very dangerous to the safety of the balloon, from acid vapor that might pass into it every time the cask required replenishing with fresh materials, which it did very frequently. To obviate this difficulty in some degree, the stopcock in the neck of the balloon answered a good purpose, as on the introduction of new materials it could be closed to prevent the acid fumes from entering the balloon during this part of the process. Although this new arrangement answered the purpose seemingly well at first, it was found, after being used a while, to present many obstacles to a successful result. After the operation had been carried on for several hours, the materials became so much heated that a great quantity of hot vapor passed into the balloon along with the gas. To prevent the balloon from being injured by the heat, a constant stream of water was pumped against it. This also answered to condense the hot vapor into water. In order to discharge the water from it, it was frequently necessary to detach the balloon from the inflating apparatus.

After working in this way until nine o'clock at night, they got the balloon about one-third filled; and in this state it was left until the next morning, the inflation being also discontinued during the night.

The next morning, at the break of day, the operators returned to resume their labors. On arriving at the place, they were exceedingly surprised to find the balloon completely distended, although it had been but partly filled the day before. On examining the machine, they discovered that the stopcock in the neck of the balloon had been left open, which suffered the common air to enter, and, with the gas already in it, to make it completely full. This, however, did not discourage the experimenters. They immediately expelled all the air from the balloon, and commenced their operations anew, with apparently more energy and hope than the previous day. They labored assiduously until about six o'clock in the evening, when, to their great satisfaction,

they saw the balloon giving evident signs of buoyancy; and at seven o'clock they found it to exert considerable effort against the rope above it to which it had been suspended. Everything was now properly secured against all impending danger, and the operations discontinued until the next day.

The following day, the 25th, they resumed their labors early in the morning. They did not on this morning, as the one previous, find anything wrong or calculated to mar their future progress. A fresh supply of gas was introduced, and at six o'clock in the morning the balloon was found to be capable of lifting up twenty-one pounds. The generation of gas was again discontinued, and at nine o'clock in the evening it was found to have a lifting power of eighteen pounds, having lost three pounds of levity during the day. This was attributed to the needle-holes, which were not properly filled up with varnish, and through which, it was presumed, the gas had leaked. It was again secured for the night, and the operators retired from their work.

On the following morning, being the 26th, the balloon was found to have lost a gradual proportion of gas and levity. The apparatus was again replenished with the proper materials, and a further quantity of gas was worked into the balloon. This was continued until eight o'clock in the morning, when it was again detached from the machinery. Having now a strong ascending power, it was secured by cords, by which it was suffered to rise to the height of more than a hundred feet, when it was drawn down again. This, as might naturally be supposed, brought together a great number of people. From these partial flights of letting it up and hauling it down again, the assemblage became so great that it was found necessary to secure the balloon to the place where it had been inflated, and a guard of soldiers placed around it to prevent the crowd from pressing too closely on it and causing it some injury. Such was their curiosity that they had already broken through the prescribed limits, and nothing short of a strong guard was found capable of ensuring its safety.

The spot where the operations had been carried on was near the place of Victories, and that appointed for the ascension of the balloon was the Champs de Mars. The distance between these two points is about two miles. In order to avoid, as much as possible, the difficulty of conveying the balloon from the former to the latter place amidst so vast a concourse of people as might be anticipated would be there, it was concluded to move it the next morning before daylight.

Accordingly, on the following morning, the 27th, at an early hour, preparations were made for its removal to the Champs de Mars. It was secured to a cart; and notwithstanding everything was in readiness to proceed before break of day, an immense concourse of people had already assembled to escort the nocturnal traveller. Torches, flambeaux, musical instruments, guns, and everything that the lively imagination of the people could suggest, were brought into requisition to render the procession grand and animating.

PEASANTS SECURING CHARLES' BALLOON.

The Champs de Mars was lined in every direction with anxious spectators. Every house-top, avenue and window along the route was filled with human beings; and as the strange and novel machine passed along, in the midst of a strong military guard of horse and foot, supporting itself in the air, reflecting the light of the numerous torches, giving it the appearance, at a distance, of a bright star, the air fairly rung with the shouts of the assembled and pleased multitude. Having arrived at its place of destination, and the proper arrangements being made to secure it from the pressure of the dense throng that already had assembled, it was again secured to the inflating apparatus, which had also been brought hither. A fresh supply of gas was introduced to make up the loss which the balloon sustained during the night. It also gave the people an opportunity of seeing how the inflation was conducted. Thus the day passed on, with constantly increasing accessions to the great multitude already present. At length the discharge of artillery, at five o'clock in the afternoon, announced the signal for the experiment. The balloon was released from its moorings, and rose before the eyes of some hundred of thousands of astonished spectators amidst a copious shower of rain. Its ascent was extremely rapid, and in the short space of two minutes it attained a height of 3123 feet. This was ascertained by observations made with instruments expressly provided for that purpose. Above this elevation the balloon was lost in a dark cloud. This was signalized by another discharge of cannon. Soon after, it reappeared for a moment, but was finally hidden behind the clouds. During the time of its visible flight the very air was made to reverberate with shouts and demonstrations of satisfaction, a heavy shower of rain to the contrary notwithstanding. After it had remained in the atmosphere for three quarters of an hour, it descended in a field near Gonesse, a village about fifteen miles distant from the Champs de Mars. The balloon was immediately discovered and secured by some peasants who were working in a field near its place of descent.

The manifestations of joy, and the satisfactory exclamations of the vast multitude of people that had assembled on this occasion, are most graphically described by some of the journals of that day. Although the ascent of an aërostatic machine was not of itself any longer calculated to inspire such a lively interest, this was the test of a new principle, which, if successful, was calculated to give a fresh impulse to aërial navigation, on account of its greater feasibility than the rarefied air principle.

The liberality and energy that characterized this experiment, the obstacles that were surmounted in an unexplored and critical science, the devotion and interest of the people manifested toward a successful result, reflect honor on its projectors. It marked an epoch in the history of the world that will increase in interest so long as the arts and sciences shall hold an equal pace with its progressive movement.

## CHAPTER V.

Infatuated conceptions of aërial voyages.

NOW that a new door had been opened through which the genius of man could take a view into the future destinies of a new science, a feeling which had a tendency to overrate the value of the discovery was inspired. An overheated zeal, fostered by an ambitious desire to explore the grand mysteries of the Creator, necessarily brought about a reaction that was calculated to do more harm than good in improving the new science. The infatuation of men carried their minds beyond the legitimate sphere of their operations. The exploration of their own world and its mysteries was no longer sufficient to give interest adequate to their expectations and attainments. Greater and more magnificent projects dazzled their bewildered minds. The grand ultimatum of human aspirations had been solved in the problem of aërostation. Man could now build himself a "castle in the air." He was no longer subservient to the laws of gravitation, which bound him to the land and the water. He felt that more than Bishop Wilkins' words had been realized, when he said, "It will be as common for a man hereafter to call for his wings when about to make a journey as it is now to call for his boots and spurs." To make a long journey or to circumnavigate the earth fell into insignificance, compared with the projects and ideas that were conceived. The earth appeared now related to man as the haycock in the field was to the lark, when he mounted its top with expanded wings to launch himself into the immensity of space. Voyages to the moon and neighboring planets haunted the imagination of more than weak minds. The binding cord of gravitation had been severed, and there was no restraint above. No one could define the limit of operations to this new and important discovery. The traditions of flying oracles which were handed down by profane and sacred history were now looked upon as realities which had been discovered and lost to human ingenuity. All the glories of the past, the present and the future seemed to be resolved in the re-discovery of this grand art. The fanciful dreams and midnight visions of the Parisians were not the only disturbed slumbers of that period. All civilized Europe had its genius startled at the news of the academical experiment. All eyes were turned to

Paris as the point of embarkation for other worlds. It stood now as a dépot in the solar system. Even the skeptical in religion began to think that a more exalted destiny awaited man than to sink in the earth and sleep for ever in its mouldering ashes.

These overwrought imaginings and premature speculations subsided as the sober and considerate experiments advanced. While the public mind resumed a natural equilibrium in regard to aërial navigation, the scientific and ingenious were not backward in promoting its utility. The first adventurers were not disparaged in their pursuits by discovering the immutable laws that confine all things to their legitimate sphere. Although the idea of emigrating to foreign worlds soon vanished from the minds of men, there still existed and progressed a perseverance to render the discovery useful for terrestrial purposes that conferred an honor on that age.

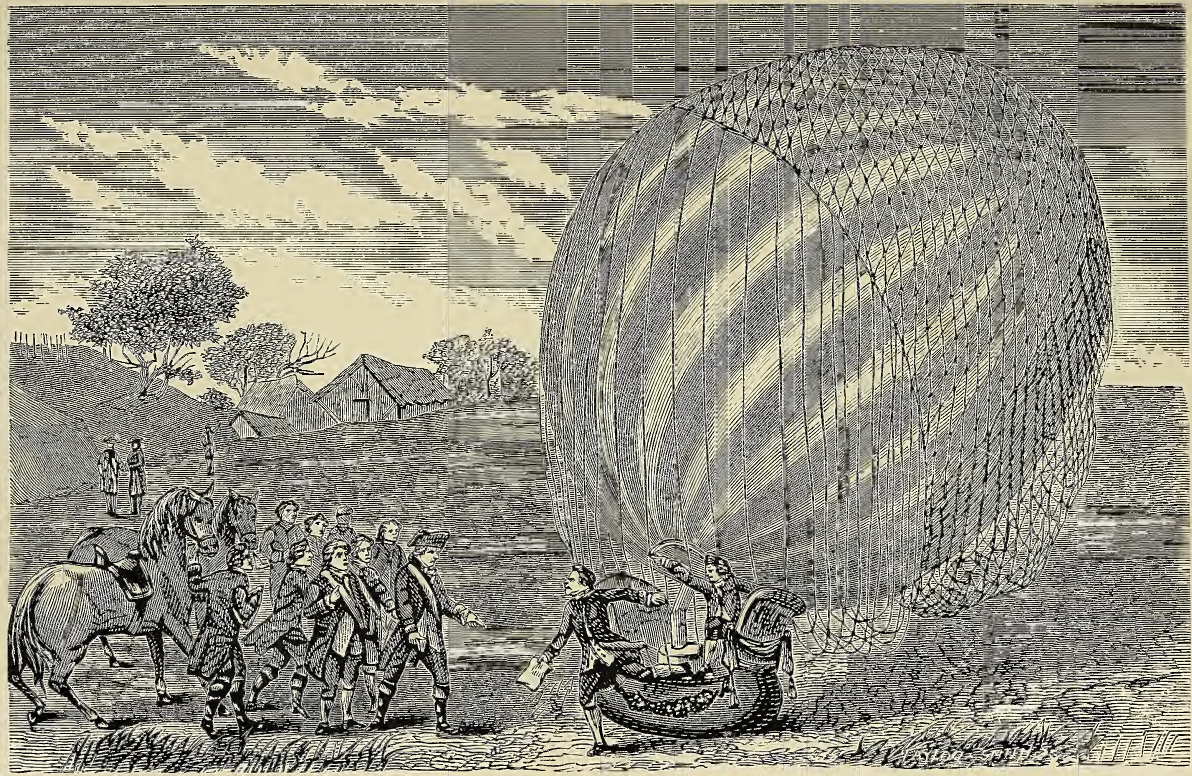
This will be shown in the historical details that will be given of the experiments that followed the discovery of the hydrogen balloon. Although the experiment which was instituted by the Academy of Arts and Sciences of Paris, to test the use of hydrogen gas instead of the dangerous mode of keeping up a rarefaction of air by the use of fire, proved eminently successful, it was still contended by the friends of Montgolfiers' plan that the heated-air principle was the best. And it will be observed that the advocates of the Montgolfierian plan gave strong reasons to sustain their position. They succeeded in many of their experiments far beyond what the best contrived rarefied air plans warranted. Aërial voyages of great interest and success were made with extraordinarily large rarefied air balloons in various parts of France.

The same perseverance and intrepidity that prevailed in the promotion of aërial navigation about the time of the discovery of air-balloons could not fail, if revived at the present time, to give it an impetus in the scale of improvement that would ere long realize all that was anticipated upon its first discovery by its sober-minded advocates. But like every other subject, it must have its time. Time alone will overcome the doubts and opposition of those who denounce it through the want of a proper understanding of its real merits.

# CHAPTER VI.

First aërial voyage with a hydrogen balloon—Experiments to regulate its direction and rising and falling—Blanchard's voyage across the sea—Compound aërostat and fatal result—Testu's remarkable voyage.

THE successful experiment with the first hydrogen balloon encouraged anew the desire for aërial voyages. M. Charles and the two Messrs. Roberts resolved to undertake an aërial excursion with a balloon filled with hydrogen gas. One was accordingly prepared by the Messrs. Roberts of varnished silk. It was of a spherical form, twenty-seven feet in diameter, and had a car suspended from it for the accommodation of the adventurers. To prevent any danger from the expansion of the gas under a diminished pressure of the atmosphere in the upper regions, the balloon was furnished with a valve, formed in such a manner as to permit the free discharge of gas when occasion required. On the 17th of December, 1783, M. Charles and one of the Roberts, having previously ascertained the direction of the wind by launching a small balloon, ascended from Paris to the height of 6000 feet, and after a voyage of an hour and three quarters descended at a distance of twenty-seven miles from the place of their departure. After their descent M. Roberts got out of the car, which lightened the vessel about 130 pounds, which enabled M. Charles to re-ascend, and in twenty minutes he attained an elevation of 9000 feet above the surface of the earth. At this immense height, he says, all terrestrial objects totally disappeared from his view. The thermometer stood at 47 degrees when he left the earth, but in the space of ten minutes it fell to 21 degrees. The effects which so rapid a change of situation produced upon him were violent in the extreme; he was benumbed with cold, and felt a severe pain in his right ear and jaw. The balloon passed through different currents of air, and in the higher regions the expansion of the gas was so powerful that M. Charles was obliged to allow part of it to escape in order to prevent the bursting of the balloon. After having risen to the height of 10,500 feet, he came down about a league from the place where he left his companion out of the car. The balloon, including the two aëronauts, thermometer, barometer and ballast, weighed 640 pounds, and the hydrogen gas was found on calculation to be about five and one quarter times lighter than common air.



DESCENT OF CHARLES AND THE MESSRS. ROBERTS.

Jean Pierre Blanchard, an ingenious Frenchman, who had spent a great deal of time in trying to perfect a mechanical contrivance by which he might be enabled to fly, was the next to construct a balloon upon the hydrogen gas plan. This was also twenty-seven feet in diameter. He ascended from Paris on the 2d of March, 1784, accompanied by a Benedictine friar. After rising fifteen feet the balloon was precipitated to the ground with a violent shock, upon which the friar, apprehensive of his safety, was induced to abandon his seat. M. Blanchard then ascended alone, and attained a height of 9600 feet. He met with various currents of air. He suffered from extreme cold and became oppressed with drowsiness, and finally descended, after a voyage of an hour and a quarter. In order to direct his course he used on this occasion an apparatus consisting of a rudder and two wings, which were attached to his car, but it was found that the apparatus exerted little or no influence over the balloon either in this or in subsequent voyages.

In April, 1784, MM. Morveau and Bertrand adopted a similar expedient, which they found to operate very sensibly on the direction of their balloon. They rose about 13,000 feet high, where they enjoyed one of the most sublime and magnificent prospects that the imagination could conceive. The mass of clouds that floated in silent disorder through the regions below them presented the appearance of a serene and boundless ocean, while a beautiful parhelion of concentric circles that began to form as the sun went down heightened the grandeur of the scene. In the month of June following, M. de Morveau undertook another voyage, which, as well as the former, commenced at Dijon. His balloon was twenty-five feet in diameter, and was made of varnished taffeta.

A similar device for regulating the course of the balloon was resorted to by the Messrs. Roberts, who had before ascended together. Their former balloon was converted into an oblong spheroid, forty-six feet by twenty-seven, the longer axis being parallel to the horizon, and the car, which was seventeen feet long, had five wings or oars disposed around it for the purpose of steering. The Messrs. Roberts and M. Collin Hullin upon entering the car of this machine threw out twenty-four pounds of ballast, which produced a gentle ascent. The current of air between the altitudes of 600 and 4200 feet was uniform. On arriving at the height of 14,000 feet they encountered some stormy clouds, which they endeavored to avoid by alternately ascending and descending. In three hours from their ascent they heard two peals of thunder, when the thermometer fell from seventy-seven to fifty-nine degrees. Finding themselves soon afterward becalmed, they had recourse to their oars, by the exertion of which their balloon in thirty-five minutes described an elliptical segment whose shortest diameter was 6000 feet. After travelling 150 miles in the space of six hours and a half they descended in safety.

The Messrs. Roberts, accompanied by the duke of Orleans and a

fourth person, ascended in July, 1784, in a balloon different in its structure from any that had hitherto been tried. On all former occasions aëronauts had found the method of effecting a descent by a discharge of gas attended with inconvenience, and to obviate this difficulty the Messrs. Roberts had suspended a small balloon within the large one. This interior balloon was to be filled with common air by means of bellows attached to it by tubes whenever they wished to descend, it being justly supposed that the addition of common air would increase the weight, as its diminution would, on the other hand, lighten the balloon. This expedient, however, though promising in theory, did not answer in practice. In the space of three minutes they rose to a height where not an object was to be seen but the clouds that surrounded them. The balloon, no longer obeying their management, was tossed with the most violent agitation, as if from one whirlwind to another. The cords by which the interior balloon was suspended giving way, it fell down in such a position as completely to close up the aperture which communicated between the large balloon and the car. A sudden gust of wind next drove them beyond the region of the storm; but the expansion of the hydrogen within the vessel increasing, they dreaded the bursting of the balloon, and being unable to remove the small one, which now obstructed the aperture, they continued to ascend. It finally gave way in two places; and notwithstanding the imminent danger to which they were exposed from the rapidity of the descent caused by this accident, they all landed without being hurt.

Though several experiments on the ascensive power of balloons had been made in England during the course of the year after their discovery, the first aërial voyage, which was undertaken by Vincent Lunardi, an Italian, did not take place till September, 1784. His balloon was thirty-three feet in diameter, and shaped like a pear. It was made of oiled silk, with alternate stripes of blue and red, having the car suspended from a hoop below the balloon by forty-five cords.

The most remarkable aërial voyage that was made soon after the discovery of aërostatic machinery was accomplished by M. Blanchard, in company with Dr. Jeffries, an American physician, who was at the time residing in England. On the 7th of January, 1785, on a clear frosty day, the balloon was launched from the cliff of Dover, and after a somewhat perilous adventure, they crossed the Channel in something less than three hours. The balloon after its release rose slowly and majestically in the air; they passed over several ships, and enjoyed a grand prospect of numerous objects below them. They soon, however, found themselves beginning to descend, which put them to the necessity of throwing over half their ballast when they were about one-third way across the Channel. When they got about halfway across, they found themselves descending again, upon which they threw over the balance of their sand, also some books they had with them. All this failed to overcome the gravitating power of the balloon. They next commenced throwing overboard their apparatus—cords, grapples

BLANCHARD'S DESCENT.

and bottles. An empty bottle seemed to emit smoke as it descended; and when it struck the water, the shock of the concussion was sensibly felt by the aëronauts. Still, their machine continued to descend, when they next betook themselves to throwing off their clothing; but having now nearly reached the French coast, the balloon began to ascend again, and rose to a considerable height, without compelling them to dispense with much of their apparel. They passed over the highlands between Cape Blanc and Calais, and landed near the edge of the forest of Guiennes, not far beyond Calais. The magistrates of the town treated the aërial travellers with the utmost kindness and hospitality. The king of France made M. Blanchard a present of 12,000 livres as a token of appreciation of his perseverance and skill in the newly-discovered art.

Several hundred ascensions had now already been made, and not a single fatal accident had yet taken place; but we are now compelled to record one which proved most disastrous to its projectors; and when we fairly estimate its design, it seems as though it could hardly have terminated otherwise. Pilâtre de Rozier and M. Romain were anxious to return the compliment of Blanchard and Dr. Jeffries by crossing over the Channel from France to England. For the purpose of avoiding the difficulty which attended Blanchard's balloon in keeping her up, they constructed a compound balloon. This was arranged by suspending a fire balloon underneath the hydrogen balloon. The fire balloon was intended to regulate the rising and falling of the whole machine. The hydrogen balloon was of a globular shape, forty feet in diameter; the other was about ten feet in diameter. After various delays, occasioned by adverse winds, de Rozier, with M. Romain, set out from Boulogne on the 15th of June, 1785. Scarcely a quarter of an hour had elapsed, when, at the height of about 3000 feet, the whole apparatus was discovered to be on fire. Its scattered fragments, with the unfortunate bodies of the aëronauts, fell to the ground near the sea-shore, about four miles from Boulogne. The aërial voyagers were instantly killed by the tremendous crash, and their bodies were of course awfully mangled.

Another very remarkable voyage was that of M. Testu, who, on the 18th of June, 1785, ascended from Paris. His balloon was twenty-nine feet in diameter, constructed by himself of glazed tiffany, furnished with auxiliary wings, and filled, as had now become the fashion, with hydrogen gas. It had been much injured by wind and rain during the night before its ascension; but having undergone a slight repair, it was finally launched with its conductor at four o'clock in the afternoon. The barometer then stood 29.68 inches, and the thermometer as high as eighty-four degrees, though the day was cloudy and threatened rain. The balloon had at first been filled only five-sixths, but it gradually swelled as it became drier and warmer, and acquired its utmost distension at the height of 2800 feet. But to avoid the waste of gas or the rupture of the balloon the navigator calculated to descend by the re-

action of his wings. Though this force had little efficacy, yet at half-past five o'clock he softly alighted in a corn-field in the plain of Montmorency. Without leaving the car he began to collect a few stones for ballast, when he was surrounded by the proprietor of the corn and a troop of peasants, who insisted on being indemnified for the damage occasioned by the idle and curious visitors. Anxious now to disengage himself, he persuaded them that, his wings being broken, he was wholly at their mercy. They seized the stay of the balloon, which floated at some height, and dragged their prisoner through the air in a sort of triumph toward the village. But M. Testu, finding that the loss of his wings, his cloak and some other articles had considerably lightened the machine, suddenly cut the cord and took an abrupt leave of the clamorous and mortified peasants. He rose to the region of the clouds, where he observed small frozen particles floating in the atmosphere. He heard thunder rolling beneath his feet, and as the coolness of the evening advanced the buoyant power of his vessel diminished, and at three quarters after six o'clock he approached the ground with his car near the abbey of Royaumont. There he threw out some ballast, and in the space of twelve minutes rose to a height of 2400 feet, where the thermometer stood only at sixty-six degrees. He now heard the blast of a horn, and descried some huntsmen below in full chase. Curious to witness the sport, he pulled the valve, and descended at eight o'clock between Ecouen and Varville, when, rejecting his oars, he set himself to gather some ballast. While he was thus occupied the hunters galloped up to him. He then mounted a third time, and passed through a dense body of clouds, in which thunder followed lightning in quick succession.

> "With fresh alacrity and force renewed
> Springs upward, like a pyramid of fire,
> Into the wild expanse, and through the shock
> Of fighting elements, on all sides around
> Environed, wins his way."

The thermometer fell to twenty-one, but afterward regained its former point of sixty-six degrees, when the balloon had reached an altitude of 3000 feet. In this region the voyager sailed till half-past nine o'clock, at which time he observed from his "watch-tower in the sky" the final setting of the sun. He was now quickly involved in darkness, and enveloped in the thickest mass of thunder-clouds. The lightning flashed on all sides, and the loud claps were incessant. The thermometer, seen by the help of a phosphoric light with which he had provided himself, stood at twenty-one degrees, and snow and sleet fell copiously around him. In this most tremendous situation the intrepid adventurer remained the space of three hours, the time during which the storm lasted. The balloon was affected by a sort of undulating motion upward and downward, owing, he thought, to the electrical

FIRST ASCENSION IN ENGLAND.

action of the clouds.* The lightning appeared excessively vivid, but the thunder was sharp and loud, preceded by a sort of crackling noise. A calm at last succeeding, he had the pleasure of seeing the stars, and embraced this opportunity to take some necessary refreshments. At half-past two o'clock the day broke in; but his ballast being nearly gone, he finally descended a quarter before four o'clock near the village of Campremi, about sixty-three miles from Paris.

* It is caused by the uprising current of air which always prevails in thunder-storms. This would drive his balloon up to the top of the clouds, from whence it would fall into the vortex below again. In a subsequent chapter I will describe a similar experience of my own. J. W.

## CHAPTER VII.

Invention of the parachute—Experiments with it.

As the *parachute* properly belongs to the subject of aëronautics, we must not defer giving its earliest introduction and use in the practice of aërial navigation. As the chief danger in the early practice of balloon voyages consisted in accidental and rapid descents, the parachute was introduced to countervail this danger, and also for enabling the aërial voyager, in case of alarm, to desert his balloon in mid-air, and drop, without sustaining injury, to the ground. The French language, though not very copious, has yet supplied this convenient term, signifying *a guard for falling*, as it has likewise furnished several analogous words, *parapluie, paravent;* and *parasol*, to denote an umbrella or sun-screen. The parachute very much resembles the ordinary umbrella in shape, but is much larger. The umbrella itself, requiring such strength to bear it up against a moderate wind, might naturally have suggested the application of the same principle to break the fall of a body coming from a great height. To effect this nothing was required but to present a surface having dimensions sufficient to experience from the air a resistance equal to the weight of descent, in moving through the fluid with a velocity not exceeding that of the shock which a person can sustain without danger of injury. Accordingly, in the East, where the umbrella, or rather the parasol, has been from the remotest ages in familiar use, this implement appears to be occasionally employed by vaulters for enabling them to jump safely from great heights. Father Loubere, in his curious account of Siam, relates that a person, famous in that remote country for his dexterity, was accustomed to divert exceedingly the king and the royal court by the prodigious leaps which he took, having two umbrellas with long slender handles fastened to his girdle. He generally alighted on the ground, but was sometimes carried by the force of the wind against trees and houses, and not unfrequently into the river. Not a great many years ago the umbrella was, at least on one occasion, employed in Europe for similar purposes, as well as in our own country. In the campaign of 1793 a French general, named Bournonville, having been sent by the

DR. JEFFRIES.

National Convention, with four more commissioners, to treat with the prince of Saxe-Coburg, was, contrary to the faith or courtesy heretofore preserved in the fiercest wars that have raged in civilized nations, detained a prisoner with his companions, and sent to the fortress of Olmutz, where he suffered a rigorous confinement. In this cruel situation he made a desperate attempt to regain his liberty. Having provided himself with an umbrella, he jumped from a window forty feet high; but being a very heavy man, this screen proved insufficient to let him down safely. He struck against an opposite wall, fell into the ditch and broke his leg, and was carried in this condition back again to his dungeon.

Blanchard was the first person who ever constructed a parachute for the purpose of using it with a balloon in cases of accident while aloft. During an excursion which he took from Lisle, about the end of August, 1785, when he traversed, without halting, a distance not less than 300 miles, he let down a parachute with a basket fastened to it, containing a dog, from a great height, which fell gently through the air and let the animal down to the ground unhurt. Since that period the practice and management of the parachute have been carried much farther by other aëronauts, and particularly by M. Garnerin, who has dared repeatedly to descend from the region of the clouds with that very slender machine. This ingenious and spirited Frenchman visited London during the short peace of 1802, and made two fine ascents with his balloon, in the second of which he let himself fall from an amazing elevation with a parachute. This consisted of thirty-two gores of white canvas formed into a hemispherical shape of twenty-three feet in diameter, at the top of which was a round piece of wood ten inches in diameter and having a hole in its centre, admitting short pieces of tape to fasten it to the several gores of the canvas. About four feet and a half below the top, a wooden hoop of eight feet diameter was attached by a string from each seam; so that, when the balloon rose, the parachute hung like a curtain from this hoop. Below it was suspended a cylindrical basket, covered with canvas, about four feet high and two and a quarter wide. In this basket the aëronaut, dressed in a close jacket and a pair of trowsers, placed himself, and rose majestically from an enclosure near North Audley street, at six o'clock in the evening of the 2d of September. After hovering seven or eight minutes in the upper region of the atmosphere, he meditated a descent in his parachute. Well might he be supposed to linger there in dread suspense, and to

"——— look a while
Pondering his voyage; for no narrow frith
He had to cross. . . . .
He views the breadth, and, without longer pause,
Downright into the world's first region throws
His flight precipitant, and winds with ease,
Through the pure marble air, his oblique way."

He cut the cord by which his parachute was attached to the net of the balloon; it instantly expanded, and for some seconds it descended with an accelerating velocity, till it became tossed extremely, and took such wide oscillations that the basket or car was at times thrown almost level or horizontal with the parachute. Borne along at the same time by the influence of the wind, the parachute passed over Marylebone and Somerstown, and almost grazed the houses of St. Pancras. At last it fortunately struck the ground in a neighboring field; but the shock was so violent as to throw poor Garnerin on his face, by which accident he received some cuts, and bled considerably. He seemed to be much agitated, and trembled exceedingly at the moment he was released from the car. One of the stays of the parachute had chanced to give way, which untoward circumstance deranged the apparatus, disturbed its proper balance, and threatened the adventurer, during the whole of his descent, with immediate destruction. At the moment of separating from the parachute, the balloon took a rapid ascending motion, and was found, next day, twelve miles distant from the place of departure.

From the principles before explained, we may easily determine the descent of a parachute, when, with its attached load, it is abandoned in the air. It must, from the continued action of gravity, proceed at first with an accelerated motion, till its increasing velocity comes to oppose a resistance equal to the force of attraction or to the combined weight of the whole apparatus. After this counterpoise has taken place, there exists no longer any cause of acceleration; the parachute should descend uniformly with its acquired rapidity. This perfect equilibrium will not, however, be attained at once. The accumulation of swiftness produced by the increasing operation of gravity is not immediately restrained by the corresponding increased resistance of the atmosphere. The motion of a parachute must hence, for some short time, be subject to a sort of interior oscillation, alternately accelerating and retarding. It first shoots beyond the terminal velocity, and then, suffering greater resistance, it relaxes, and contracts within the just limits. This unequal and undulating progress which a parachute exhibits subsequently to the commencement of its fall is calculated to excite disproportionate fears of insecurity and danger. The terminal velocity of a parachute, or the uniform motion to which its velocity tends, would, according to theory, be equal, if its surface were flat, to the velocity that a heavy body must acquire in falling through the altitude of a column of air incumbent on that surface, and having, under the usual circumstances, the same weight as the whole apparatus. But we have already seen that a cylinder of air one foot in diameter and height weighs only, in ordinary cases, the seventeenth part of a pound avoirdupois. Wherefore, if the square of the diameter of a parachute be divided by seventeen, the quotient will give the number of pounds equivalent to the weight of an atmospheric column of one foot; and the weight of the apparatus being divided again by this

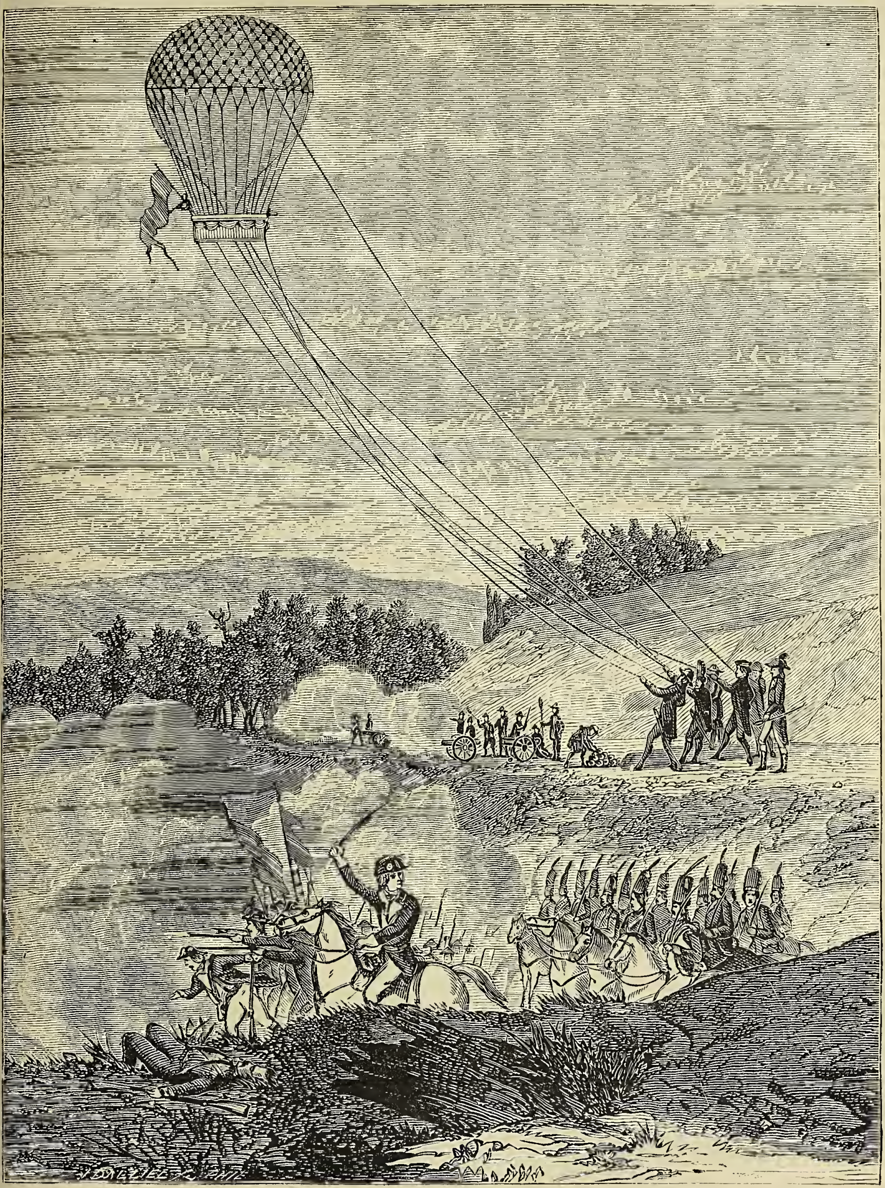
quotient, the result will express the entire altitude of an equiponderant column. Of the altitude the square root multiplied by eight will denote the final velocity, or that with which the parachute must strike the ground. But the actual resistance of the air is rather greater than what theory would give, and it is besides augmented by the concavity of the opposing surface, which occasions an accumulation of the fluid.

A parachute of a hemispherical form, twenty-five feet in diameter, is all-sufficient to let down an ordinary sized man from any height in safety. But it will be shown in the course of this work that the balloon itself will form a parachute in case of bursting while aloft. This happened to the author of this work during an ascension he made from Easton, Pennsylvania, and afterward in an excursion from the city of Philadelphia, the minute details of which will be given in another part of this work. Although the arrangements for a descent by parachute are as easy and simple as are the constructing of and ascending with a balloon, still, there are few who have ever ventured to try it. This may be ascribed mainly to two causes: First, a want of knowledge of the scientific principles by which it is governed; and secondly, because there appears to be no great utility concerned in its practice, but merely the novelty of seeing a person, as it were, jump from the clouds to the earth without being injured.

## CHAPTER VIII.

Aërostatic institute—The French applying the art to the warlike aggrandizement of their nation—Practicing school at Meudon—New method of generating hydrogen gas—Balloons for the French army—Battle of Fleurus gained by aid of balloon *reconnaissance*—Balloons for surveying and electrical experiments.

IN the early part of the French revolutionary war, when ingenuity and science were so eagerly called into active service, the *savans* of the French Academy recommended the use of balloons for purposes of *reconnaissance*. Under their auspices an aëronautic school was established at Meudon, near Paris. It was got up with the utmost secrecy, so that the powers opposed to the French could not avail themselves of its advantages until the first projectors had already used it in such an effective manner as to greatly paralyze the allied powers. In order to have it at once facile and useful, it was necessary to have it managed on scientific principles. The management of the institution was committed to the most eminent philosophers of Paris. Guyton Morveau, the celebrated French chemist, and M. Contel superintended its operations. Fifty young military students were admitted to this school for training. A balloon of thirty-two feet in diameter was constructed, of the most durable materials, as a practicing machine for these pupils. Although the original plan of generating hydrogen gas was by decomposing water with the aid of oil of vitriol and iron filings and borings, Morveau introduced another method in this case. For this purpose six iron cylinders were fixed by masonry in a simple kind of furnace, each of their ends projecting and covered with an iron lid. Two sets of metal tubes were also inserted into these lids, one for conveying in the water and the other for carrying off the gas which was formed from the water. The cylinders being charged with iron turnings and brought to a red heat, the humidity of the water was instantly converted into steam, whose expanded particles were soon decomposed by the oxygen uniting with the red-hot iron, forming an oxide of iron, while the hydrogen was thus freed and forced out by its own pressure from the other tube, and from thence through a washer of lime-water, to deposit the carbonic acid gas that might adhere to it, and then it was perfectly pure and ready for the balloon.



THE BATTLE OF FLEURUS.

By this method they procured, at a very moderate expense, a quantity of gas sufficient to inflate a balloon thirty-two feet in diameter, which held 17,000 cubic feet, in the space of four hours. The practicing balloon was kept constantly full, so as to be at all times ready for exercise; and when not in use, it was fastened to the terrace of the lodge, in the open air. Whenever the weather was fair, the colonel of the corps and a pupil seated themselves in the car, when the machine was suffered to rise five or six hundred feet, by means of cord and windlass. This primary movement in military aëronautics became of great interest, from the advantages it seemed to possess. Paris, at this time being the great military focus of the world, could by these means view with Argus eyes the movements around the great metropolis. Telegraphic communication to the governmental centre was greatly facilitated by the aëronautic observers. A balloon was also constructed for this school, which, when filled with hydrogen, required the strength of twenty men to keep it to the earth. It could, after the lapse of two months, without in the mean time being replenished with gas, raise into the air two men, with necessary ballast and all the instruments of observation. The eminent artist M. Contel constructed balloons especially appropriated to the different divisions of the French army—the *Entreprenant* for the army of the North, the *Celeste* for that of the Sambre and Meuse, the *Hercule* for the army of the Rhine and Moselle, and the *Intrepide* for the memorable army of Egypt.

In June, 1794, M. Contel ascended in the war balloon *Entreprenant* to reconnoitre the hostile army, just before the battle of Fleurus, accompanied by an adjutant and general. They rose to a height of several thousand feet, with their windlass machinery so arranged that they could make it stationary at any given altitude. They mounted twice in the course of that day, and remained up each time four hours. During the second aërial *reconnaissance* they were discovered by the enemy, causing consternation and surprise within their lines. A brisk cannonade upon the aërial man-of-war ship, however, soon followed; but the observers, not being very high at the time, soon elevated themselves to a point at which they finished their observations in defiance of the enemy's cannon. Upon this they descended safely, and by the signals communicated to General Jourdan he was enabled to gain a speedy and decisive victory over the Austrian forces on the plains of Fleurus.

The French government also used the art of aëronautics for the purpose of surveying and locating geographical lines. M. Lomet was appointed to superintend these operations. He found considerable difficulty in conducting his observations, from the irregular motion of the balloon, over which he had no controlling power. He, however, concluded that the practice of aërial topography was of great use in facilitating geographical surveys.

The Abbé Bertholon also used balloons in his electrical experiments. They were sent up attached to long slender wires, which were fastened

to the earth by the intervention of glass rods, or some other non-conducting substance. The balloons had fine projecting pointed wires proceeding from them; these wires connected with the main conducting wire, which went down to the earth, where it was connected with a prime receiver. By this method he was enabled to collect the electric fluid in abundance. I would, however, caution experimenters who may wish to follow his example. Trying this method with merely a hempen line for the main cord, which was wetted with a metalized solution as the balloon ran up with it, I found the sparks so rapid and powerful given out from a tin ball six inches in diameter, which was insulated below, as to make it extremely painful to draw them off by the bare hand, and they became so extremely rapid that I was induced to desist, for fear of serious consequences. This experiment I made immediately preceding a thunder-storm, and the balloon was not more than four hundred feet high. Any danger liable to arise from such experiments might, however, be avoided by having the fixtures and instruments properly arranged for the purpose.

## CHAPTER IX.

First scientific ascension—Philosophical aërial voyage of Gay-Lussac and Biot—Their experiments—Second ascent of Lussac—His experiments.

THE first balloon ascension in the interests of science was made on July 18, 1803, from Hamburg, by Robertson and Lhoëst. A start was made at nine o'clock in the morning, and the aëronauts remained five hours and a half in the air, descending near Hanover, about seventy-five miles distant. The altitude reached by the balloon was 23,526 feet, and the thermometer fell as low as 19.6°. On the ground it stood at 68°. Eight distinct experiments were conducted on this voyage. The first demonstrated that at the highest point in the atmosphere reached, glass, sulphur and wax scarcely became at all electrified. The second proved that a voltaic battery only produced five-sixths of the action upon the electrometer that it did upon the earth. The third indicated that the dipping-needle increases its oscillation with the height above the earth. The fourth experiment consisted in exploding ten grains of chlorate of potash so as to produce a sharp crack. The sound was much less powerful and less easily diffused than on the ground. It was intended by the fifth experiment to discover at what temperature water would boil at the height named; but owing to the breaking of the thermometer, this came to nothing. The sixth experiment consisted in noting the odor of a drop of sulphuric ether; it was exceedingly pungent, but useful in overcoming feelings of faintness. The seventh experiment was the liberation of a bird. Two were taken up, but one of them died; the other, when thrown over the side of the car, dropped heavily, like a piece of lead. In the eighth experiment it was noted that the sky was a dark gray color and the heat of the sun very slight.

A report of this voyage was transmitted to the Academy of Sciences of St. Petersburg, and that body determined that another one should be made under its own auspices. Mr. Robertson and Herr Sacharoff, a member of the academy and a distinguished chemist, accordingly ascended on the 30th of June, 1804, at seven hours and forty-five minutes in the evening, from St. Petersburg, and after a journey of about sixty miles descended at ten hours and forty-five minutes near Sivoritz. The ba-

rometer on the ground marked thirty inches, and the thermometer 74¾° Fahrenheit. At the greatest altitude reached these instruments stood at twenty-two inches and 42.1°. The aëronauts concluded therefore that the altitude was 8.868 feet. The magnetic experiments undertaken on this occasion did not produce any satisfactory results.

The next important ascensions made for scientific purposes were those of MM. Gay-Lussac and Biot, of which the following account is given by Sir John Leslie:

"After the capitulation at Cairo, the balloon which had been sent to Egypt was returned to Paris, after the French army had returned from the African deserts. Two young and ardent French philosophers, MM. Biot and Gay-Lussac, proposed to undertake an aërial excursion, in order to examine the magnetic force at great elevations, and to explore the constitution of the higher atmosphere and its electrical properties. For such a philosophical enterprise they were eminently qualified, having been educated together at the Polytechnic School of Paris, and both of them being deeply versed in mathematics, the former indulging in a wide range of study, and the latter concentrating his efforts more on chemistry and its application to the arts. Their offer to government was seconded by Berthollet and Laplace, and the celebrated chemist Chaptal, then minister of the interior, gave it his patronage and warm support. The war balloon which had once been in Egypt was now given to the custody of Biot and Gay-Lussac, and the same artist who constructed it was, at the public expense, ordered to refit and prepare it under their direction. Besides the usual provision of barometers, thermometers, hygrometers and electrometers, they had two compasses and a dipping-needle, with another fine needle, carefully magnetized, and suspended by a very delicate silk thread, for ascertaining by its vibrations the force of magnetic attraction. To examine the electricity of the different strata of the atmosphere, they carried several metallic wires, from sixty to three hundred feet in length, and a small electrophorus, feebly charged. For galvanic experiments they had procured a few disks of zinc and copper, with some frogs, to which they added some insects and birds. It was also intended to bring down a portion of air from the higher regions, to be subjected to a chemical analysis; and for this purpose a flask, carefully exhausted and fitted with a stopcock, had been prepared for them.

"The balloon was placed in the garden of the *Conservatoire des Arts*, or Repository of Models, formerly the Convent of St. Martin, and no pains were spared by Contel in providing whatever might contribute to the greater safety and convenience of the experimental voyagers. Everything being now ready for their ascent, these adventurous philosophers, in the presence of a few friends, embarked in the car at ten o'clock on the morning of the 23d of August, 1804. The barometer was then at 30.13 inches, the thermometer at 61° on Fahrenheit's scale, and Saussure's hygrometer pointed at 80.8°, or very nearly the limit of absolute humidity. They rose with a slow and imposing mo-

tion. Their feelings were at first absorbed in the novelty and magnificence of the spectacle which opened before them, and their ears were saluted with the buzz of distant gratulations sent up from the admiring spectators. In a few minutes they entered the region of the clouds, which seemed like a thin fog, and gave them a slight sensation of humidity. The balloon had now become quite inflated, and they were obliged to let part of the gas escape by opening the upper valve; at the same time they threw out some ballast, to gain a greater elevation. They now shot up through the range of clouds, and reached an altitude of about 6500 English feet. These clouds, viewed from above, had the ordinary whitish appearance; they all occupied the same height, only their upper surface seemed marked with gentle swells and undulations, exactly resembling the aspect of a wide plain covered with snow.

"MM. Biot and Gay-Lussac now began their experimental operations. The magnetic needle was attracted, as usual, by iron, but they found it impossible at this time to determine with accuracy its rate of oscillation, owing to a slow rotary motion with which the balloon was affected. In the mean while, therefore, they made other observations. A voltaic pile, consisting of twenty pairs of plates, exhibited all its ordinary effects—gave the pungent taste, excited the nervous commotion and occasioned the decomposition of water. By rejecting some more ballast they attained the altitude of 8940 feet, but afterward settled to that of 8600 feet. At this great elevation the animals which they carried with them appeared to suffer from the rarity of the air. They let off a violet bee, which flew away swiftly, making a humming noise. The thermometer had fallen to 56° Fahrenheit, yet they felt no cold; they were, on the contrary, scorched by the sun's rays,* and were obliged to lay aside their gloves. Both of them had their pulses much accelerated; that of Biot, which generally beat seventy-six times in a minute, was raised to one hundred and eleven, while the pulse of his friend Gay-Lussac, a man of a less robust frame, was heightened from sixty to eighty beats in the minute. Notwithstanding their quickened pulsation, however, they experienced no sort of uneasiness, nor any difficulty in breathing.

"What perplexed them most was the difficulty of observing the oscillations of a delicately suspended magnetic needle. But they soon remarked, on looking attentively down upon the surface of the conglomerated clouds, that the balloon slowly revolved first in one direction and then returned the contrary way. Between the opposite motions there intervened short pauses of rest, which it was necessary for them to seize. Watching, therefore, the moments of quiescence, they set the needle to vibrate, but were unable to count more than five, or very rarely ten, oscillations. A number of trials made between the altitudes

* I have always found the sun oppressive when sailing over dense strata of clouds. The heat is caused by reflection. This was the case in this instance. J. W.

of 9500 and 13,000 feet gave 7″ for the mean length of an oscillation, while at the surface of the earth it required $7\frac{1}{20}''$ to perform each oscillation. A difference so very minute as the hundred and fortieth part could only be imputed to the imperfection of the experiment, and it was hence fairly concluded that the force of magnetic attraction had in no degree diminished at the greatest elevation which they could reach. The direction of this force, too, seemed, from the concurring circumstances, to have continued the same, though they could not depend on observations made in their vacillating car with so delicate an instrument as the dipping-needle.

"At the altitude of 11,000 feet they liberated a green linnet, which flew away directly; but soon feeling itself abandoned in the midst of an unknown ocean, it returned, and settled on the stays of the balloon. Then, mustering fresh courage, it took a second flight, and dashed downward to the earth, describing a tortuous yet almost perpendicular track. A pigeon, which they let off under similar circumstances, afforded a more curious spectacle. Placed on the edge of the car, it rested a while, measuring, as it were, the breadth of that unexplored sea which it designed to traverse; now launching into the abyss, it fluttered irregularly, and seemed at first to try its wings on the thin element, till, after a few strokes, it gained more confidence, and whirling in large circles or spirals, like the birds of prey, it precipitated itself toward the mass of extended clouds, where it was lost from sight.

"It was difficult, in those lofty and rather humid regions, to make electrical observation, and the attention of the scientific navigators was, besides, occupied chiefly by their magnetical experiments. However, they let down from the car an insulated metallic wire of about 250 feet in length, and ascertained, by means of the electrophorus, that the upper end indicated resinous or negative electricity. This experiment was several times repeated, and it seemed to corroborate fully the previous observations of Saussure and Volta relative to the increase of electricity met with in ascending the atmosphere.

"The diminution of temperature in the higher regions was found less than what it generally is at the same altitude on mountains.* The hygrometer, or rather hygroscope, of Saussure advanced regularly toward dryness in proportion to the altitude which they attained. At the elevation of 13,000 feet it had changed from 80.8° to 30°. But still the conclusion that the air of the higher strata is drier than that of the lower we are inclined to consider as fallacious. In fact, the indications of the hygroscope depend on the relative attention for humidity possessed by the substance employed and the medium in which it is immersed. But air has its disposition to retain moisture always augmented by rarefaction, and consequently such alteration alone must

* This want of diminution was caused by the reflection of the sun from the cloud stratum below them. J. W.

materially affect the hygroscope. The only accurate instrument for ascertaining the condition of air with respect to dryness is founded on a property of evaporation. But we shall afterward have occasion to refer to this.

"The ballast now being almost quite expended, it was resolved to descend. The aëronauts, therefore, pulled the upper valve, and allowed part of the hydrogen gas to escape. They dropped gradually; and when they came to the height of 4000 feet, they met the stratum of clouds, extending horizontally, but with a surface heaved in gentle swells. When they reached the ground, no people were near them to stop the balloon, which dragged them in the car to some distance along the fields. From this awkward and even dangerous situation they could not extricate themselves without discharging a great quantity of gas, and therefore gave up the idea of sending Gay-Lussac up alone to explore the highest regions. It has been reported that his companion Biot, though a man of activity and not deficient in personal courage, was so much overpowered by the alarms of their descent as to lose for the time the entire possession of himself. The place where they alighted at half-past one o'clock, after three hours and a half spent in the midst of the atmosphere, was near the village of Meriville, in the department of the Loiret, and about fifty miles from Paris.

"Several philosophers of Paris now desired that Gay-Lussac should mount a second time, and repeat the different observations at the greatest elevation he could attain. Experience had instructed him to reduce his apparatus, and to adapt it better to the actual circumstances. As he could only count the vibrations of the magnetic needle during the very short intervals which occurred between the contrary rotations of the balloon, he preferred one about six inches in length, which, therefore, oscillated more quickly. The dipping-needle was magetized and adjusted by the ingenious M. Coulomb. To protect the thermometer from the direct action of the sun, it was enclosed within two concentric cylinders of pasteboard covered with gilt paper. The hygrometers, constructed by Richer's mode, with four hairs, were sheltered nearly in the same way. The two glass flasks intended to bring down air from the highest regions of the atmosphere had been exhausted till the mercurial gauge stood at the twenty-fifth part of an inch, and their stopcocks were so perfectly fitted that after the lapse of eight days they still preserved the vacuum. These articles, with two barometers, were the principal instruments which Gay-Lussac took with him. The skill and intelligence of the artist had been exerted in further precautions for the safety of the balloon.

"At forty minutes after nine o'clock, on the morning of the 15th of September, 1804, the scientific voyager ascended as before from the garden of the Repository of Models. The barometer then stood at 30.66 English inches, the thermometer at 82° Fahr. and the hygrometer at 57½°. The sky was unclouded, but misty. Scarcely had the aëronaut reached the height of 3000 feet when he observed spread

below him, over the whole extent of the atmosphere, a thin vapor which rendered the distant objects very indistinct. Having gained an altitude of 9950 feet, he set his needle to vibrate, and found it to perform twenty oscillations in 83″, though it had taken 84.33″ to make the same number at the surface of the earth. At the height of 12,680 feet he discovered the variation of the compass to be precisely the same as below, but with all the pains he could take he was unable to determine with sufficient certainty the dip of the needle. He continued to prosecute his other experiments with the same diligence and with greater success. At the altitude of 14,480 feet he found that a key held in the magnetic direction repelled with its lower end and attracted with its upper end the north pole of a needle of a small compass. This observation was repeated, and with equal success, at the vast height of 20,150 feet—a clear proof that the magnetism of the earth exerts its influence at remote distances. He made no fewer than fifteen trials at different altitudes with the oscillations of his finely-suspended needle. It was generally known to vibrate twenty or thirty times. The mean result gives 4.22″ for each oscillation, while it is 4.216″ at the surface of the earth—an apparent difference so extremely small as to be fairly neglected.

"During the whole of this gradual ascent he noticed at short intervals the state of the barometer, the thermometer and the hygrometer. Of these observations, amounting in all to twenty-one, he has given a tabular view. We regret, however, that he has neglected to mark the times at which they were made, since the results appear to have been very materially modified by the progress of the day. It would likewise have been desirable to have compared them with a register noted every half hour at the Observatory. From the surface of the earth to the height of 12,125 feet the temperature of the atmosphere decreased regularly from 82° to 47.3°, by Fahrenheit's scale, but afterward it increased again, and reached to 53.6° at the altitude of 14,000 feet, evidently owing to the influence of the warm currents of air which as the day advanced rose continually from the heated ground. From that point the temperature diminished with only slight deviations from a perfect regularity. At the height of 18,636 feet the thermometer subsided to 32.9°—on the verge of congelation—but it sunk to 14.9° at the enormous altitude of 22,912 feet above Paris, or 23,040 feet above the level of the sea, the utmost limit of the balloon's ascent.

"From these observations no conclusive inference, we think, can be drawn respecting the mean gradation of cold which is maintained in the higher regions of the atmosphere; for as we have already remarked, the several strata are during the day kept considerably above their permanent temperature by the hot currents raised from the surface through the action of the sun's rays. If we adopt the formula given by Professor Leslie at the end of his 'Elements of Geometry,' which was the result of some accurate and combined researches, the diminu-

tion of temperature corresponding to the first part of the ascent, or 12,152 feet, ought to have been 40° Fahr. It was actually 34.7°, and would no doubt have reached to 40°, if the progressive heating of the surface during the interval of time were taken into the account. In the next portion of the voyage, from the altitude of 14,000 to that of 18,636 feet, or the breadth of 4636 feet, the decrement of temperature, according to the formula, should have been only 16¼°, instead of 20.7°, which was really marked—a proof that the diurnal heat from below had not yet produced its full effect at such a great height. In the last portion of the balloon's ascent, from 18,636 feet to 22,912, a range of 4276 feet, the decrease of heat ought to have been 15½°, and it was actually 18°, owing most probably to the same cause, or the feebler influence which warm currents of air from the surface exert at these vast elevations. Taking the entire range of the ascent, or 22,912 feet, the diminution of temperature, according to the same formula, would be for the gradation of temperature in ascending the atmosphere 85.4°. The decrease actually observed would be 67.1°, which might be raised to 80°, if we admit the very probable supposition that the surface of the earth had become heated from 82° to 94.9° during the interval between ten o'clock in the morning and near three in the afternoon, when the balloon floated at its greatest elevation.

"After making fair allowances, therefore, on account of the operation of deranging causes, the results obtained by Gay-Lussac for the gradation of temperature in the atmosphere appear, on the whole, to agree very nearly with those derived from the formula which theory, guided by delicate experiments, had before assigned. This gradation is evidently not uniform, as some philosophers have assumed, but proceeds with augmented rapidity in the more elevated regions. The same conclusion results from a careful inspection of the facts which have been stated by other observers.

"The hygrometers, during the ascent of the balloon, held a progress not quite so regular, but tending obviously toward dryness. At the height of 9950 feet they had changed from 57.5° to 62°, from which they continued afterward to decline, till they came to mark 27.5° at the altitude of 15,190 feet. From this inferior limit the hygrometers advanced again, yet with some fluctuations, to 35.1°, which they indicated at the height of 18,460 feet. Above this altitude the variation was slight, though rather inclining to humidity. There can exist no doubt, however, that, allowing for the influence of the prevailing cold, the higher strata of the atmosphere must be generally drier than the lower, or capable of retaining, at the same temperature, a larger share of moisture.

"At the altitude of 21,460 feet, Gay-Lussac opened one of his exhausted flasks, and at that of 21,790 feet the other. The air rushed into them through the narrow aperture with a whistling noise. He still rose higher; but at eleven minutes past three o'clock he had

attained the utmost limit of his ascent, and was then 22,912 feet above Paris, or 23,040 feet (being more than four miles and a quarter) above the level of the sea. The air was now more than twice as thin as ordinary, the barometer having sunk to 12.95 inches. From that tremendous altitude, 1600 feet higher than the summit of the Andes, more elevated than the loftiest pinnacle of our globe and far above the height to which any mortal had ever soared, the aërial navigator might have indulged the feelings of triumphant enthusiasm. But the philosopher, in perfect security, was more intent on calmly pursuing his observations. During his former ascent he saw the fleecy clouds spread out below him, while the canopy of heaven seemed of the deepest azure—more intense than Prussian blue. This time, however, he perceived no clouds gathered near the surface, but remarked a range of them stretching at a very considerable height over his head; the atmosphere, too, wanted transparency, and had a dull, misty appearance. The different aspect of the sky was probably owing to the direction of the wind, which blew from the north-west in his first voyage, but in his second from the south-east.

"While occupied with experiments at this enormous elevation, he began, though warmly clad, to suffer from excessive cold, and his hands, by continual exposure, became benumbed. He felt likewise a difficulty in breathing, and his pulse and respiration were much quickened. His throat became parched from inhaling the dry, attenuated air, so that he could hardly swallow a morsel of bread; but he experienced no other direct inconvenience from his situation. He had indeed been affected through the whole of the day with a slight headache, brought on by the preceding fatigues and want of sleep; but though it continued without abatement, it was not increased by his ascent.

"The balloon was now completely distended, and not more than thirty-three pounds of ballast remained; it began to drop, and Gay-Lussac, therefore, only sought to regulate its descent. It subsided very gently, at the rate of about a mile in eight minutes; and after the lapse of about thirty-four minutes, or at three quarters after three o'clock, the anchor touched the ground and instantly secured the car. The voyager alighted with great ease near the hamlet of St. Gourgan, about sixteen miles from Rouen. The inhabitants flocked around him, offering him assistance and eager to gratify their curiosity.

"As soon as he reached Paris, he hastened to the laboratory of the Polytechnic School with his flasks, containing air of the higher regions, and proceeded to analyze it in the presence of Thenard and Gresset. Opened under water, the liquid rushed into them, and apparently half filled their capacity. The transported air was found, by a very delicate analysis, to contain exactly the same proportions as that collected near the surface of the earth, every 1000 parts holding 215 of oxygen. From concurring observations, therefore, we may conclude that the atmosphere is essentially the same in all situations.

"The ascents performed by MM. Biot and Gay-Lussac are memora-

ble as being the first ever undertaken solely for objects of science. It is impossible not to admire the intrepid coolness with which they conducted these experiments, operating, while they floated in the highest regions of the atmosphere, with the same composure and precision as if they had been quietly seated in their cabinet at Paris. Their observations on the force of terrestrial magnetism show most conclusively its deep source and wide extension. The identity of the constitution of the atmosphere, to a vast altitude, was likewise ascertained. The facts noted by Gay-Lussac relative to the state of the thermometer at different heights appear generally to confirm the law which theory assigns for the gradation of temperature in the atmosphere; but many interesting points were left untouched by this philosopher. We are sorry that he had not carried with him the *cyanometer*, which enabled Saussure to determine the color of the sky on the summits of the Swiss mountains; still more do we regret that he was not provided with an hygrometer and a photometer of Leslie's construction. These delicate instruments could not have failed, in his hands, to furnish important data for discovering the relative dryness and transparency of the different strata of air. It would have been extremely interesting, at such a tremendous height, to have measured with accuracy the feeble light reflected from the azure canopy of heaven, and the intense force of the sun's direct rays, and hence to have determined what portion of them is absorbed in their passage through the lower and denser atmosphere."

# CHAPTER X.

Suggestions on the use of balloons soon after their discovery.

AT this point in our narrative the following speculations, indulged in by a writer during the early days of the science of aëronautics, will be of interest:

"Balloons have at different times been thought capable of useful application. It has even been proposed to employ their power of ascension as a mechanical force. This might be rendered efficient, it was believed, to raise water from mines, or to transport obelisks and place them on great elevations. We can easily imagine situations where a balloon could be used with advantage—such as to raise, without any scaffolding, a cross or a vane to the top of a high spire; but the power would then be purchased at a very disproportionate expense. It would require four and a half pounds of iron or six of zinc, with equal quantities of sulphuric acid, to yield hydrogen gas sufficient to raise up the weight of a pound. Balloons have rendered important service in reconnoitring the face of a country and communicating military signals, and it is rather surprising that a system which promised such obvious advantages has not been carried much farther.

"But to a skilful and judicious application of balloons we may yet look for a most essential improvement of the infant science of meteorology. Confined to the surface of this globe, we have no direct intimation of what passes in the lofty regions of the atmosphere. All the changes of weather, which appear so capricious and perplexing, proceed, no doubt, from the combination of a very few simple causes. Were the philosopher to penetrate beyond the seat of the clouds, examine the circumstances of their formation and mark the prevailing currents, he would probably remove, in part, the veil that conceals those mighty operations. It would be quite practicable, we conceive, to reach an elevation of seven miles, where the air would be four times more attenuated than ordinary. A silk balloon of forty feet diameter, if properly constructed, might be sufficient for that enormous ascent, though not more than one-fourth filled with hydrogen gas. The voyager would not, we presume, suffer any serious inconvenience from breathing

the thin air;* the animal frame adapts itself with wonderful facility to external circumstances. Perhaps the quickened pulse and short respiration which some travellers have experienced on the summits of lofty mountains should be attributed chiefly to the suddenness of their transition and the severity of the cold. The people of Quito live comfortably 9560 feet above the level of the sea, and the shepherds of the hamlet of Antisana, the highest inhabited spot in the known world, who breathe, at an elevation of 13,500 feet, air that has only three-fifths of the usual density, are nowise deficient in health or vigor. But the intenseness of the cold is, probably, what the resolute observer would have most to dread at the height of seven miles. This decrease of temperature, perhaps equal to 148°, might extend below the point at which mercury freezes; yet several circumstances tend to mitigate such extreme cold, and proper clothing might enable an experimenter for a short time to resist its effects.

"Much could be done, however, without risk or material expense. Balloons from fifteen to thirty feet in diameter, and carrying register thermometers and barometers, might be capable of ascending alone to altitudes between eight and twelve miles. Despatched from the centres of the great continents, they would not only determine the extreme gradations of cold, but indicate by their flight the direction of the regular and periodic winds, which doubtless obtain in the highest regions of the atmosphere. But we will not enlarge. In some happier times such experiments may be performed with the zealous concurrence of different governments, when nations shall at last become satisfied with cultivating the arts of peace, instead of wasting their energies in sanguinary, destructive and fruitless wars."

* He would suffer from a diminution of atmospheric pressure. At the surface of the earth, an ordinary-sized man sustains an atmospheric pressure of over 25,000 pounds, while at the height of seven miles he would have but 6500 pounds. From what I have experienced at three and a quarter miles high, I would suppose very serious consequences would ensue at that immense height. J. W.

## CHAPTER XI.

Aërial voyage of M. Mosment from Lisle—Lost his life by it—Nocturnal aërial voyage of M. Garnerin from Paris—His ascent from Tivoli—Perilous trip—Caught in a thunder-storm.

ON the 7th of April, 1806, M. Mosment, an experienced aëronaut, undertook an aërial voyage from Lisle. He ascended at noon, waving a flag decorated with the imperial eagle of France, amid the shouts of the assembled spectators. The commencement of his career was so rapid as to bear him in a very short time beyond the vision of the crowd. During his ascent he dropped an animal attached to a parachute, which came safely to the ground. About one o'clock something was observed slowly descending through the atmosphere, which proved on its fall to be the flag which M. Mosment had carried along with him. Very soon afterward a murmur circulated through the crowd, and the body of the unfortunate aëronaut was discovered in one of the fosses of the city lifeless and covered with blood. The balloon reached the ground on the same day at the distance of twenty-five leagues from Lisle, the car containing nothing except an unloaded pistol, a little bread and a piece of flesh. M. Garnerin ascribes this melancholy disaster to the extreme shallowness of the car and to the too great distance between the cords which attached it to the balloon, and is of opinion that M. Mosment when leaning over the car to drop the animal had lost his balance, and was precipitated to the earth.

Of all the voyages which the history of aëronautics presents to our notice, the nocturnal aërial excursions of M. Garnerin must be ranked among the most enterprising and adventurous. At eleven o'clock on the evening of the 4th of August, 1807, he ascended from Tivoli, at Paris, under the Russian flag, as a token of the peace that subsisted between France and Russia. His balloon was illuminated by twenty lamps, and to obviate all danger of communication between these and the hydrogen gas which it might be necessary to discharge in the course of the voyage, the nearest of the lamps was fourteen feet distant from the balloon, and conductors were provided to carry the gas away in an opposite direction. After his ascent rockets which had been let off from Tivoli seemed to him scarcely to rise above the earth, and

Paris with all its lamps appeared like a plain studded with luminous spots. In forty minutes he found himself at an elevation of 13,200 feet, when, in consequence of the dilation of the balloon, he was under the necessity of discharging part of the inflammable air. About twelve o'clock, when 3600 feet from the earth, he heard the barking of dogs; about two he saw several meteors flying around him, but none of them so near as to create apprehension. At half-past three he beheld the sun emerging in brilliant majesty above an ocean of clouds; and the gas in the balloon being thereby expanded, it soon rose 15,000 feet above the surface of the earth, where he found the cold to be exceedingly intense. In seven hours and a half from his departure, M. Garnerin descended near Loges, forty-five leagues distant from Paris.

This same intrepid aëronaut undertook a second nocturnal voyage on the 21st of September, 1807, in the course of which he was exposed to the most imminent danger. M. Garnerin, prognosticating an approaching storm from the state of the atmosphere, refused to be accompanied by M. de Chassenton, who earnestly requested it. He ascended, therefore, alone from Tivoli at ten o'clock, and was carried up with unexampled rapidity to an immense height above the clouds. The balloon was then dilated to an alarming degree, and M. Garnerin, having been prevented by the turbulence of the mob before his ascent from regulating those parts of the apparatus which were meant to conduct the gas away from the lamps on its escape, was totally incapable of managing the balloon. He had no alternative left, therefore, than with one hand to make an opening two feet in diameter, through which the inflammable air was discharged in great quantities, and with the other to extinguish as many of the lamps as he could possibly reach. The aëronaut was now without a regulating valve, and the balloon, subject to every caprice of the whirlwind, was tossed about from current to current. When the storm impelled him downward, he was forced to throw out his ballast to restore the ascending tendency, and at last, every resource being exhausted, no expedient was left him to provide against future emergencies. In this forlorn condition the balloon rose through thick clouds and afterward sank; and the car, having struck against the ground, with a violent impulse rebounded from it to a considerable altitude. The fury of the storm dashed him against the mountains, and after many rude agitations and severe shocks he was reduced to a state of temporary insensibility. On recovering from this perilous situation he reached Mont Tonnerre in a storm of thunder. A very short period after this his anchor hooked in a tree, and in seven hours and a half, after a voyage which had nearly proved fatal to him, he landed at the distance of 300 miles from Paris.

We might enumerate a great many voyages undertaken with balloons about the beginning of the present century, but we have preferred to take only such from among them as seem to be best calculated to impart useful information on the subject to the student of aëronautics. Some of the accounts are also too highly exaggerated to enter a sober history.

## CHAPTER XII.

Prospects of aërial navigation—Fulton and Napoleon—General introduction of carburetted hydrogen auspicious to aërial navigation.

WE have now taken a review of the experiments and trials in the art of aëronautics which transpired within the period of a few years after its discovery; and although it is frequently said that it has not been improved beyond its original invention, it is more than probable that the reader will come to a more favorable conclusion on the perusal of this work. True it may be that, as yet, no actual demonstration has been made to prove that we can sail from point to point with a balloon with the same precision and certainty that we can with steamships. And if we had no other prospects on which to rest our hopes and anticipations, in acquiring such perfection, we have at least the consolation of knowing that steamship navigation, for more than local purposes, was as much decried and denounced as visionary as a means of crossing the ocean, fifty years ago, as trans-Atlantic balloon navigation is now. In 1801, Napoleon Bonaparte was rising in the most auspicious period of his glory, and his military genius was apparently concentrated upon the necessity of England's reduction. Concerning this, Alison says a singular circumstance occurred at that time, which demonstrates how little the clearest intellect can anticipate the ultimate result of the discoveries which are destined to effect the greatest changes in human affairs. At the time when all eyes in Europe were fixed on the Channel, and the orators of the French tribune were wishing for a "fair wind and thirty-six hours," an unknown individual (Robert Fulton) presented himself to the First Consul, and said: "The sea which separates you from your enemy gives him a great advantage. Aided alternately by the winds and tempests, he braves you in his inaccessible isle. This obstacle, his sole strength, I engage to overcome. I can, in spite of all his fleets, at any time, in a few hours, transport your armies into his territory, without fearing the tempests or having need of winds. Consider the means which I offer you." A most singular proposition was this, truly. Napoleon so far entertained it as to commit the plans and details of Mr. Fulton to a commission of the most learned men which France could produce, and this was all

that the First Consul's vast engagements would allow him to do. The most learned commission reported to Napoleon that it was "visionary and impracticable." Such was the reception which steam navigation, that has done so much, first received at the hands of philosophy.

It is even so with aërial navigation at the present day—condemned and pronounced "visionary," instead of receiving that support and encouragement which would at least enable it to have a fair trial in the several ways that are at present proposed and urged. To hear the murmurings of some that the art has not been improved is one of the most happy omens, to the practical aëronaut, of what it soon will be. He alone is capable of fairly valuing this view of the subject, when he compares the knowledge and facilities we possess of its operations at the present day with those at the period of its discovery. The cost of construction of balloons has been reduced more than one-half from what it was sixty years ago. The means of making them impermeable to hydrogen gas has also been vastly improved, to say nothing of what is likely to come out of the important discoveries and improvements in gum elastic and gutta percha. Then comes the general introduction of carburetted hydrogen, or coal gas, into every important town in the United States, bringing within the compass of ordinary means the cost of inflating balloons for experimental purposes. While the cost of inflating one of these machines which is capable of carrying an individual amounted to at least one hundred and fifty dollars by the vitriolic process, it costs but twenty-five or thirty dollars to fill one with coal gas capable of raising the same weight, and affords a good profit to the gas company at that. Here, then, a wide and desirable field is opening, and which, to a great extent, is already opened, calculated to give the art a new life, by inviting its friends and promoters to conduct experiments and effect improvements. This is the more encouraging because we are not groping in the dark, seeking an untried, unphilosophical phantom, but a mathematically demonstrated truth, which is only awaiting an actual realization. For that the air is navigable is no longer to be denied; its practicability, as a generally useful art, is merely doubted.

# CHAPTER XIII.

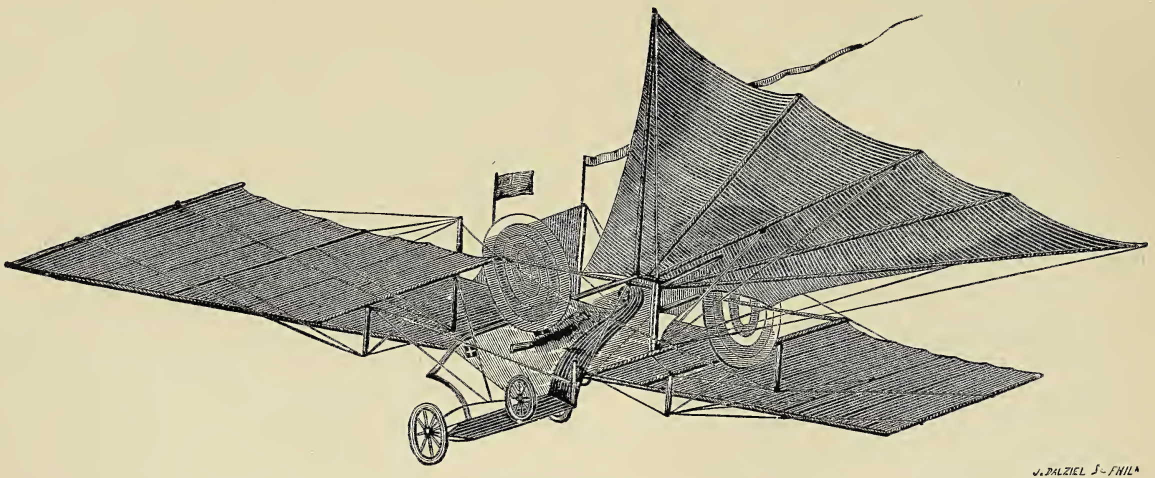
Pennington's flying machine—Connection of balloon with it—Anonymous claimant to the invention of screw propeller—His views on balloon sailing—Steam not adaptable to balloon propulsion—Henson's aërial steam carriage—A description of it from "Newton's Journal"—Its contrivance more ingenious than practicable.

IN examining into and commenting on this subject, the means and contrivances which have been resorted to by various individuals who have in modern times attempted to navigate the air with machines entirely independent of balloons should not be overlooked. Although such contrivances seem to be behind the balloon principle, from never yet having accomplished any real results to prove their efficiency, still, some of them are very ingenious, are not without value, and are, therefore, worthy of being fairly considered in this work. It is by examining every collateral and approximating advantage pertaining to this subject in the minutest degree that we shall be enabled to attain the highest point of perfection in the shortest possible time.

The first of these machines that we shall notice is the one suggested by Mr. John H. Pennington, of Baltimore, Md.

In order that a fair estimate may be made of Mr. Pennington's views on the subject of aërial navigation, connected with what he claims as his invention, his own explanation is here submitted:

"The principle is the lateral pressure of the atmosphere, acting upon the inclined plane, the propelling power and wheel. The machine or inclined plane will resemble in figure the transverse section of a spheroid, in either side of which are openings for the purpose of admitting a pair of beveled wheels, by which the machine is to be propelled, and centrally situated between these is a small engine, by which the wheels are to be put in motion by a chain band connected with the engine. It is proposed to have the engine made of steel, so as to secure the greatest possible strength in the smallest possible compass, and to use spirits of turpentine or alcohol, which boil at about thirty-three and a half per cent. less heat than water, when 300 per cent. of strength may be obtained by using these materials, and the same proportionate weight of metal being dispensed



J. DALZIEL Sᶜ PHILᴬ

HENSON'S FLYING MACHINE.

with, which, being calculated to work two and a half or three horse power, and to carry 450 lbs. exclusively of weight of engine, fuel and dilating fluid, average 500 lbs. more. This would make a total of 950 lbs., which would require an extent in width of about 125 feet by 375. This, multiplied by itself and one-third of the quotient deducted, would leave the number of square feet contained in the area of the disk of the inclined plane of the machine.

"The wheels which are intended to propel the plane forward are spiral or bevelled-winged, situated in openings on either side of the plane, and formed on the common principle of the windmill wheel. To the lower extremity of the plane is attached the steering power, capable of moving either vertically or horizontally. To calculate, then, the power of the machine, it must be considered in a state of equilibrium—that is, in the state where the power just balances it which is to overcome the resistance of the atmosphere. Having discovered what quantity of power will be requisite for this purpose, it will then be necessary to add so much more as to overcome the friction and weight of the machine itself, and to give the necessary velocity. The whole machine, then, in all its simplicity, resolves itself into the principle of the common boy's *kite*, the bevelled-winged wheels the momentum and the engine the power."

Having met with Mr. Pennington at Winchester, Va., while making arrangements for a balloon ascension from that place, I advised him to place a balloon instead of a kite as a buoyant power to his flying machine, and this suggestion he at once adopted. The application of bevelled wheels to the propulsion of aërial machinery did not originate with Mr. Pennington, nor can it be ascribed to any one in particular, as the use of them would naturally suggest itself to any one who was engaged in the investigation of aërial navigation. Mr. C. Green, of London, the veteran aëronaut, used them in an experimental model of a flying machine, a balloon, at an exhibition of his air-navigating machine before the Polytechnic School of London, before Mr. Pennington presented his claim to their application for such purpose.

The same principle is claimed as having been recommended at a period prior to the use of it in steamboats. We will take the claimant's communication to the "Philadelphia Sun" newspaper of 1843 in full as being pertinent to the subject under consideration.

He says: "Though all the devices and projects directed to the object contained in the article you published on 'Navigating the Air' I consider as inefficient or futile, yet I by no means think the idea visionary or impracticable, and therefore they lead me to recur to a communication of mine inserted in the 'United States Gazette' of the 17th of June, 1828, now nearly twenty years ago, signed E. L. B. E. In it a contrivance is proposed for the purpose which all previous and subsequent reflection and observation confirm me in believing adequate to effect it, though it has not yet attracted the practical attention of any one who may be competent through his wealth and skill to give to

it a fair trial, which I should be glad to assist a party in doing. As the date of that communication is so far in the rear that perhaps few if any besides myself remember anything of it, I will briefly recapitulate its scope. In it I contemplated the accomplishment of aërial navigation by means of a mechanical contrivance derived from the well-known power and operation of revolving inclined planes, as exemplified in a windmill or in a child's plaything displayed in almost every house on the stove during the winter. Therein I held that as a current of air acting against a system of confined inclined planes causes them to revolve with great power, increasing in proportion to their surface and the strength of the current, so if the power were reversed, the planes set free and the force applied directly to them, they would project themselves *forward* with a corresponding force and velocity—the same as does a ship in similar circumstances; for, contrary to the common conception, three-fourths of a ship's sailing is performed by the sails acting as inclined planes against the current of wind instead of direct line impulse.

"Now, to practically effect my proposition, I contemplate an oblong balloon whose capacity should be but a few pounds less in ascensive power when provided with a vertical and horizontal set of rotary inclined planes than the burden it is to carry. Then but a small portion of the power of a man to the horizontal planes would cause its ascension, and a proportionate power to the vertical ones would cause its forward progress. The steering could be effected exactly in the manner of a ship, bird or fish. I have also in my head the application of a well-known very common principle of power little inferior to steam, which has but trifling weight, and requiring neither fuel nor fire, which could as certainly be brought into action as that of human or any other force.

"In the same communication (June 17, 1828) I proposed the application of this principle to the propelling of vessels, exactly as Mr. Loper has since done, efficiently in the fact, and I believe profitably so to himself, with the additional proposition of substituting inclined planes for the wind instead of steam power to move the propellers, and invited the conference of any enterprising person whose means and perceptions might be brought to favor an experiment; but though the communication was copied into some papers—particularly, I remember, the 'Boston Galaxy'—I never have heard a word of it since.

"I do not mean to imply that Mr. Loper's device is not intuitive with himself, for my observation and experience have informed me of the fact that two persons, or even more, widely distant and unknown to each other, may hit on the very same idea."

The plan laid down above is theoretically correct; and were it not for the desideratum existing in the propelling power, it were worth the while to try it. Human power is insufficient for, and steam power is not adapted to, balloon navigation; there are several insuperable difficulties connected with it, to say nothing of the danger that would con-

stantly attend its use, arising from the proximity of fire with so ignitable and explosive a substance as the gas would be that might in any way escape from the balloon and mix with the air surrounding it.

The next thing worthy of consideration we find in Henson's idea. Many persons in England were sanguine in the belief that his machine was destined to perfect the art of aërial navigation, and it was seriously contemplated to build one after his model with which to cross the Atlantic. Indeed, it was well calculated to inspire such a belief in the mere theoretical mind, but to the practical man it at once occurs, What is to keep it from tilting over in losing its balance by a flaw of wind, or any other casualty, and thus tumbling to the ground, even admitting that it could raise itself up and move forward?

The principal feature of this invention is the very great expanse of its sustaining planes, which are larger, in proportion to the weight it has to carry, than those of many birds; but if they had been still greater, they would not have sufficed of themselves to sustain their own weight, to say nothing of their machinery and cargo; surely, though slowly, they would have come to the ground. The machine advances with its front edge a little raised, the effect of which is to present its under surface to the air over which it is passing, the resistance of which, acting on it like a strong wind on the sails of a windmill, prevents the descent of the machine and its burden. The sustaining of the whole, therefore, depends upon the speed at which it is travelling through the air and the angle at which its under surface impinges on the air in its front, and this is exactly the principle by which birds are upheld in their flight with but slight motion of their wings, and often with none.

But then this result, after the start, depends entirely on keeping up the speed, and there remains beyond that the still more formidable difficulty of first obtaining that speed. All former attempts of this kind have failed, because no engine existed that was at once light enough and powerful enough to lift even its own weight through the air with the necessary rapidity. Mr. Henson removed this difficulty partly, by inventing a steam-engine of extreme lightness and efficiency, and partly by another and very singular device which requires particular notice. The machine, fully prepared for flight, was to have been started from the top of an inclined plane, in descending which it was expected to attain a velocity necessary to sustain it in its further progress. That velocity would be gradually destroyed by the resistance of the air to the forward flight; it was, therefore, the office of the steam-engine and the vanes it actuated simply to repair the loss of velocity; it was made, therefore, only of the power and weight necessary for that small effect. Here, we apprehend, was the chief, but not the only, merit and originality of Mr. Henson's invention; and to this happy thought we shall probably be indebted for the first successful attempt to traverse at will another domain of nature.

The editor of "Newton's Journal of Arts and Sciences," an excellent English periodical, speaks of it thus: "The apparatus consists of

a car, containing the goods, passengers, engine, fuel, etc., to which a rectangular frame, made of wood or bamboo cane and covered with canvas or oiled silk, is attached. This frame extends on either side of the car in a similar manner to the outstretched wings of a bird, but with this difference—that the frame is immovable. Behind the wings are two vertical fan-wheels, furnished with oblique vanes, which are intended to propel the apparatus through the air. These wheels receive motion, through bands and pulleys, from a steam- or other engine contained in the car. To an axis at the stern of the car a triangular frame is attached, resembling the tail of a bird, which is also covered with canvas or oiled silk. This may be expanded or contracted at pleasure, and is moved up or down for the purpose of causing the machine to ascend or descend. Beneath the tail is a rudder for directing the course of the machine to the right or to the left, and to facilitate the steering a sail is stretched between two masts which rise from the car.

"The amount of canvas or oiled silk necessary for buoying up the machine is stated to be equal to one square foot for each half pound weight, the whole apparatus weighing about 3000 lbs., and the area of surface spread out to support it 4500 square feet in the two wings and 1505 in the tail, making altogether 6000 square feet. The engine is proposed to be of from twenty-five to thirty horse power. It is stated in the specification that on launching the machine into the air an elevated situation must be selected, and the machine allowed to run some distance down an inclined plane, for which purpose vertical wheels are attached to the bottom of the car or boat. When the machine has thus acquired a momentum, the rotary fan-wheels are put in motion to raise it into the air and propel it; the rudder appended to the car is then used for regulating its course.

"In concluding our hasty remarks on this invention, we would remind our readers that many projects of a like character have been promulgated to the world by enthusiastic projectors, all of which have fallen to the ground (we use a figure of speech, for they have never risen), from the fact of having overlooked the laws of matter and miscalculated the powers of mechanism in imitating the functions of animal life.

"The engraving of this machine represents the aërial steamer flying. The bat-like wing or sail is the tail which turns on joints, answering the same purposes as the tail of a bird, and can be depressed, elevated, contracted or expanded at the will of the commander. The car containing the steam-engine, cargo, conductors and passengers, in suitable compartments, is represented by windows, and three wheels upon which the carriage can run on land. Aërial goes foremost, and is a little raised: to the middle of the other is joined the tail. The carriage is two hundred and fifty feet by thirty, and the tail is fifty feet long. The rainbow-like circular wheels are the propellers, answering to the wheels of a steamboat, and acting upon the air after the manner of a windmill. The car is seen at one side, owing to the difficulty of representing it in

an engraving *underneath* the surface of the carriage, where it is located, between and below the propelling wheels."

This invention was introduced about thirty years ago, and drew the attention and commendation of the scientific of both Europe and America. It certainly came nearer to the construction and consequent physical action of the bird than any that had ever preceded it. It, moreover, embraced all the most rational conceptions and fine mechanical contrivances, without the inefficient encumbrances, of all other flying machines that had ever been brought before the public. We might go on and multiply the description of plans and models that have been suggested of late years; but as the ones we have here given seem to embrace every valuable discovered feature of mechanism, it seems useless to waste time in their further investigation. Even Messrs. Porter and Robjohn's California balloon, which they designed should be propelled by steam applied to the Archimedes screw-wheel, was but a repetition of the suggestions made years before. The propulsion of the spheroidal balloon by steam or any other power, applied to the windmill-like paddle-wheel, was first shown by a working model, put in motion by a clock-spring, by Charles Green, of England, one of the most experienced aëronauts in the world, before the Polytechnic School of London, more than thirty years ago. Mr. Green went farther than this—he gave us a plan by which a balloon may be made to ascend and descend without expending ballast or gas, which was certainly more valuable in the art of aërial navigation than any improvements lately made. And even this idea ("kedging") is said to have been first suggested as available in balloon sailing by Baldwin, a writer on aëronautics.

# CHAPTER XIV.

**Flying machines—Experiments in aërial navigation—The theories of M. Nadar—M. David's aërostat.**

WITHIN the past twenty years a great number of experiments have been made with aërial machines, and inventive genius has busied itself in endeavoring to solve the problems involved in the successful navigation of the air, but thus far without practical results. That it will ultimately be accomplished is certain, for with the record of the difficulties that have been encountered and overcome in the perfecting of all the great inventions which have benefited mankind before them as an incentive to exertion, air navigators will not pause in their endeavors until their object is attained.

In our cut we show some of the principal contrivances that have from time to time been either suggested or attempted, and they will serve to give the reader some notion of the ideas of various inventions.

No. 1 is a flying globe designed by an engineer named Blainville. Exactly how the wings were to have been used is not known.

No. 2 is the Abbé Molari's Montgolfier, which was to have ascended in July, 1784. There was a lateral opening from which it was expected that the heated air would rush and propel the balloon in an opposite direction. In consequence of the destruction of the balloon by fire, no practical test of the value of the contrivance was ever made.

No. 3 is a balloon with a reversed parachute, invented by a Mr. Henin. The parachute was attached for the purpose of retarding the ascent of the air-ship and allowing the wind to act upon the sails, by which it could be propelled at pleasure the same as a ship at sea.

No. 4 is a navigable balloon invented in 1816 by Sir George Cayley.

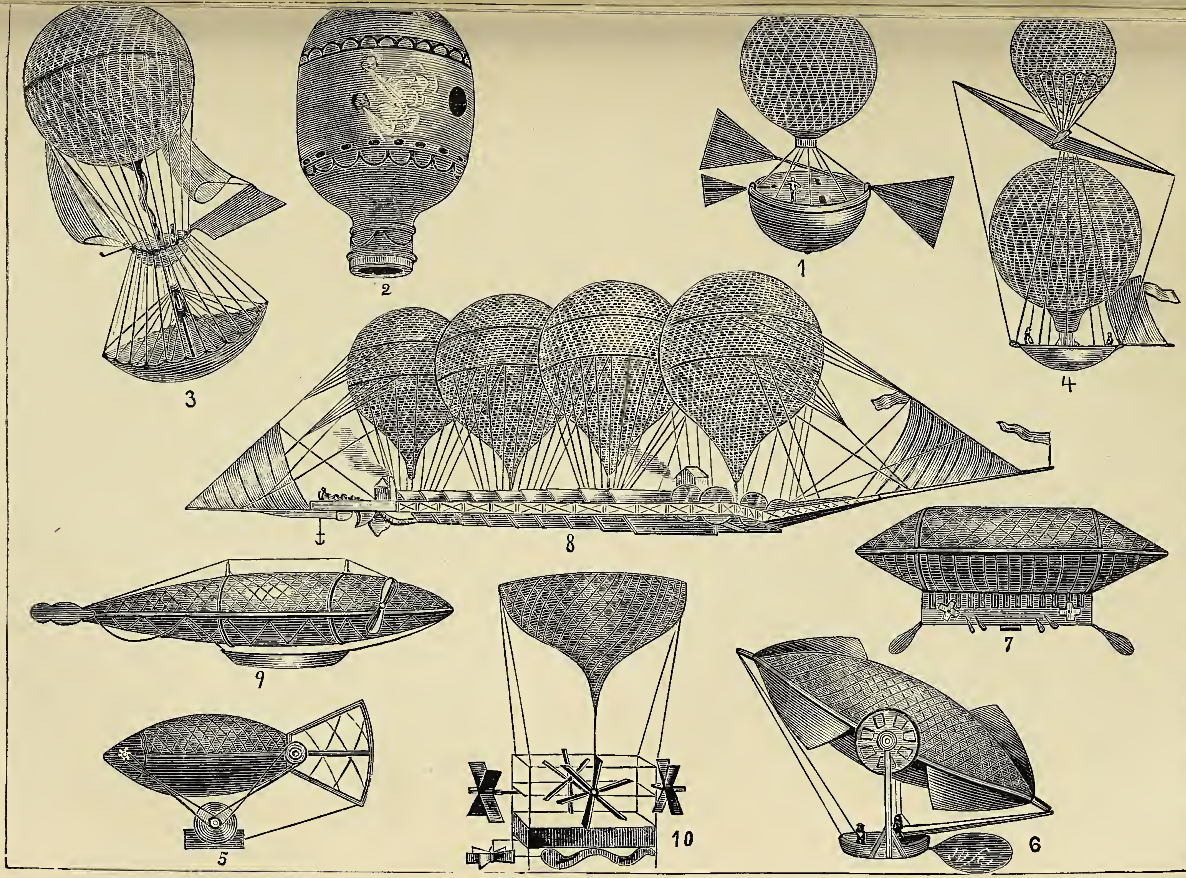
No. 5 is Samson's aërostat, furnished with fires made of feathers. No satisfactory motive-power for this machine could be contrived.

No. 6 is a machine the designer of which is unknown.

No. 7 is an aërial ship called *L'Aigle*, designed by Mr. Lennox. It was tried on the Champs de Mars in August, 1834, but failed to fulfil the expectations of its inventor.

No. 8 is the Systême Petin, made public in 1850.

No. 9 is the aërostat of M. Julien. A model 25 feet long was




AERONAUTIC EXPERIMENTS.

exhibited at the Hippodrome at Paris, and went against the wind. The motive-power was clock-work.

No. 10 is an aërial contrivance of M. Heille which was made public in 1850, but so far as we are aware was never tried. The motive-power was to have been a combination of sails and screws operated by two men.

The French aëronauts have been especially zealous in their endeavors to procure a machine which, however crude it may be in its incipiency, will succeed in traversing the air under the guidance of the human will, and thus give future inventors a firm basis upon which to work in their endeavors to bring the navigation of the air to the same perfection as we have the navigation of the ocean. Prominent among these experimenters must be named M. Nadar, an aëronaut of great skill and scientific attainments, who with his great balloon *L'Geant* did much to increase our knowledge of the upper atmosphere, and to demonstrate the importance of aëronautics as a means of obtaining information of the greatest value and importance to mankind.

M. Nadar boldly abandons the balloon as the air-ship of the future, contending that it can never be more than a floating apparatus which it will be impossible to guide at will. In 1863 he promulgated his ideas in the following terms:

> "To contend against the air, one must be specifically heavier than the air.
> All that is not absurd is possible;
> All that is possible may be accomplished."

It is impossible in a work like this, which is intended more especially for non-scientific readers, to give the elaborate reasoning of M. Nadar in support of his theories. It is sufficient to say that he believes the screw, in some combination or under some modification, is the instrument which will solve the great problem and enable man to travel through the air with greater speed and safety than he is able to do over the land or the water. The following extract from M. Nadar's writings on this subject will give some idea of the conclusions at which he arrived:

"The first necessity for aërial automotion is to disembarrass one's self of every kind of aërostat; that which aërostation refuses we must demand of dynamics and statics.

"It is the screw which is to carry us through the air, it is the screw which penetrates the air as a gimlet does wood, the one carrying with it its motive power, the other its handle.

"Every one has seen the toy called the spiralifer. It consists of four small flat fans, or rather spirals of paper, edged with wire and attached at equal distances to a central spindle of light wood. This spindle is inserted into a hollow tube, with a rotary movement, upon an immovable axis, which is held by the left hand. A string passed round the spindle, and quickly pulled by the right hand, impresses upon it a rotary movement sufficient to enable this miniature screw to detach

itself and rise several yards higher in the air, whence it descends so soon as the force imparted to it has expended itself.

"Let us now imagine spirals of a material and an extent sufficient to support any motive-power whatever—steam, ether, compressed air or the like—that this motive-power has the permanence of forces employed in ordinary industrial pursuits; and it is plain that by regulating at will, as the driver does the locomotive, you can rise, descend or remain motionless in space, according to the number of revolutions which you cause your screw to make.

* * * * * * * * * * *

"I wish as far as possible to meet beforehand every objection, so earnestly do I desire that all shall share my own convictions. I suppose, then, admitting that, after all, practice too often gives the lie to theory, some one will boldly maintain that on a larger scale—that is, on a scale commensurate with the proportions of the subject—the same results will not be obtained.

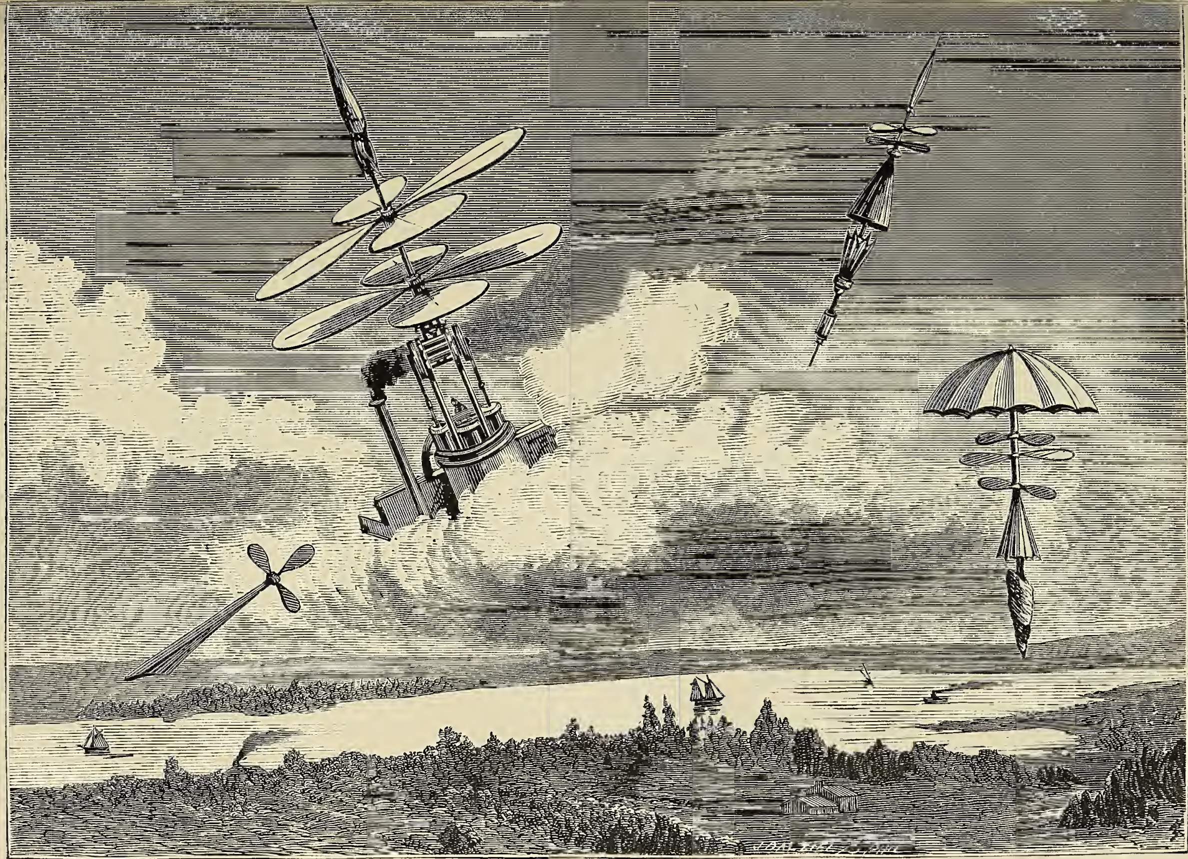
"The answer is easy. It is, on the contrary, the amplification of weight and form upon which we depend for success; and, in fact, if our principle is once admitted, if our motive-power X, representing, let us say, one-horse power, does not provide us with sufficient ascensional power, we have only one thing to do, to double the power of water. If this two-horse power be insufficient, we take four horses, or eight, since in proportion as we augment its force we diminish relatively the weight of our water. And it is very certain that a ten-horse power weighs much less than ten forces of one-horse, which give the same result. We therefore diminish our load in proportion as we increase our force.

"I think it may be admitted that the most difficult point has been passed so soon as the screw provides us with vertical ascensional power capable of being regulated at will.

"The screw will complete its work by providing us with a horizontal propeller, the rapidity of whose rotation, exceeding that of the lifting screw, will be further increased by that obtained by inclined planes; and we have thus the means of directing the machine.

"Let us consider the action of the parachute. A parachute is a sort of umbrella in which the handle is replaced at its point of insertion by an opening intended to ease the excess of air, in order to avoid the strong oscillations, chiefly at the moment at which it is first expanded. Cords stretching symmetrically from divers points of the circumference meet concentrically at the basket, in which is the aëronaut. Above this basket, and at the entrance of the folded parachute—that is to say, closed during the rise—a loop of sufficient diameter is intended to facilitate, at the moment of the fall, the entrance of the air, which, rushing in under the pressure, expands the folds more easily and rapidly.

"Now, the parachute, in which the weight of the car, of the attaching cords and the wrigglings of the aëronaut are in equilibrium with the expansion—the parachute, which seems to have no other aim but to



THE IDEAS OF M. NADAR.

moderate the shock in falling—the parachute even has been found capable of being directed, and the aëronauts who have practiced it take care not to forget it. If the current is about to drive the machine over a place where the descent is dangerous, say a river, a town, a forest, the aëronaut, perceiving to his right, let us suppose, a piece of ground suitable for his purpose, pulls at the cords which surround the right side, and by thus imparting a greater obliquity to his roof of silk glides through the air, which it cleaves obliquely toward the desired spot. Every descent, in fact, is determined by the side on which the inclination is greatest.

"The inclined planes disposed on the platform of an aërial locomotive, and combined with the ascensional power which it yields, will furnish it, then, independently of the horizontal screw, an assured means of locomotion.

"It will be understood that it belongs not to us to determine at present, in this general statement, either the mechanism or the necessary manœuvres. Neither shall we attempt to fix even approximately the future velocity of aërial locomotion. Let us rather attempt to calculate the probable velocity of a locomotive gliding through the air without the possibility of running off the rail, without any oscillation, without the least obstacle. Let us fancy such a locomotive encountering on its way one of those atmospheric currents which travel at the rate of forty leagues an hour, and following that current; add together these formidable data, and your imagination will recoil in adding still further to these giddy velocities that of a machine falling through an angle of descent of from 12,000 to 15,000 feet in a series of gigantic zigzags, and making a tour of the globe and a succession of fantastic leaps."

In 1864, M. David, a member of the French Aërostatic and Meteorological Society, published a description of a machine which he thought solved the problem of aërial navigation. Omitting M. David's argument in favor of his theories, we give this description of his machine as arranged for propulsion by sail:

"I derive the ascensional power from a lutestring gas-holder, varnished or vulcanized, of elongated form, slightly arched in its upper surface, and terminating at either end in a hemisphere (AA). I say lutestring, from its being the best tissue for the purpose hitherto invented; but there is reason to believe that metallic gas-holders will one day be constructed.

"Inside the aërostat, attached to the lower half, I place a balloon of much smaller dimensions, whereby ascent and descent can be effected without loss of gas or ballast. It is connected with a reservoir of compressed gas, placed under the car, and by mechanical means this balloon can either be filled with gas or atmospheric air, according to the wish to ascend or descend (BB).

"Netting covers the gas-holders (AA). At the lower extremities of the net, and under the gas-holder, is suspended a horizontal wooden

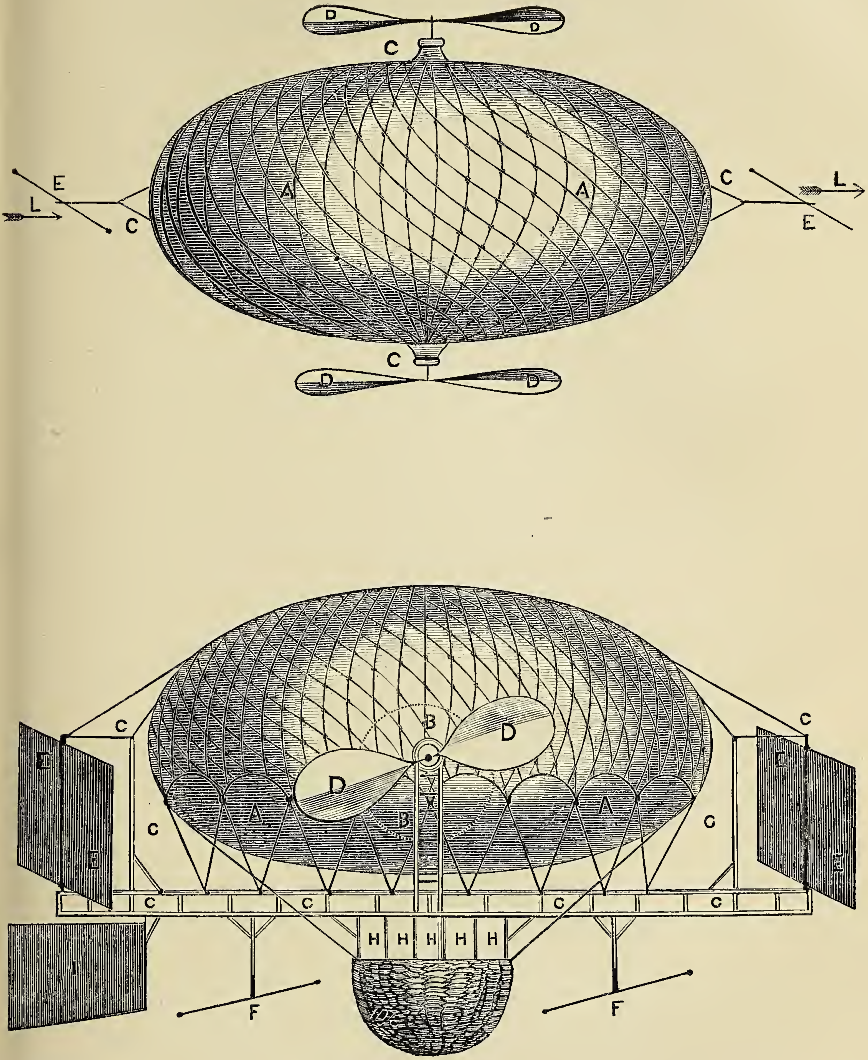
framework which serves to support the screws and the sails of which we are going to speak (CCCCCC).

"To the right and the left of the gas-holder are double-armed screws, which I shall call the lateral screws, from their position. Their length should be about equal to the gas-holder's diameter, and are so fixed that their axes should be at right angles with the length of the gas-holder. They receive their motion from an engine that may be worked either by steam or expanded air, and it is to be placed in the car (DD).

"At the prow and stern of the gas-holder are two inclined planes of stretched canvas, mounted on pivots, but only acting horizontally; these I call the horizontal sails (FF).

"Finally, under all, is the car for the passengers, provisions, and the engines for working the screws (GG). This car is attached to the framework before mentioned by several uprights of wood or iron (HHHH), and also to the netting that covers the gas-holder to prevent oscillation and to consolidate all parts of the aërostat."

The aërostat of M. David, to be propelled by mechanical means, was to be constructed, in the main, in a similar way to that just described. Unfortunately, nothing has thus far been accomplished with any of these ingenious inventions, and the balloon still continues to be the only machine we have by which it is possible to travel through the air.




DAVID'S AEROSTAT.

## CHAPTER XV.

Aërial navigation in China—Description of a Chinese aërostat.

A FEW years ago there was published in Paris a work entitled "La Navigation Aérienne en Chine, relation d'un voyage accompli en 1860 entre Fout-cheou et Naut-chang," by Delaville Dedreux, which professes to give important particulars with regard to the practice of aërial navigation among the Chinese. The author apparently drew upon his imagination for most if not all of his facts; but as his narrative is curious, the following extract, with the accompanying engraving of the aërial machine described, will interest the reader:

"The freshness of the morning was enjoyable whilst we walked down a glade through a wood that extended along the valley and up the sides of the hills on either side. It gradually narrowed till we saw it end in an amphitheatre less than a mile in circuit, with almost perpendicular sides, evidently made by the hand of man. Here we found ten aërostats of snowy whiteness, all turned in one direction. Eight glades converged starlike through the wood, and met at one opening, wherein were as many platforms, so arranged as to glide down these glades by their own weight. A circular staircase gave access to what may be called the ramparts of the amphitheatre.

"'This,' said Kie Fo, after enjoying my surprise, 'is the starting-place. Many towns have similar stations arranged by rules that the experience of centuries has rendered permanent. Their form, you will observe, protects them from all winds. Those well-worn slopes are for the descent of the towing machines; that open space is the landing-place; for descending pipes convey water in all directions, as it is required in dry weather.' We ascended the staircase and looked down the valley. As two aërostats are always joined together, we arrived opposite one, and saw several pedestrians arriving by various glades (the Chinese word for aërial starting-place corresponds with our word terminus). We noticed that it was not adapted for holding more than five equipages (that is, ten aërostats, as two are always connected). We arrived opposite one, and found a waiting-room on a level space.

"About the centre of the court I saw a chariot, low and massive, on four wheels, bearing a basket somewhat similar to the car of our European balloons. From this basket there ascended four ropes attached to a horizontal mast, ornamented at prow and stern by head and tail of a dragon. This appeared immovable about thirty feet overhead. On examining the balloon above I found that it was not egg-shaped, as I had thought at first sight, but had a cylinder terminated at each end by a cone; it was attached to and almost touched the mast. In addition to the ropes that bound the mast to the chariot were twenty others, attached to ten cars, and one reached to the ground for each car. At the centre of the mast was attached a car larger than the rest, somewhat like a large sentry box, which was quite the centre of everything, as a funnel of glazed silk connected it with the aërostat.

"'That man in the chariot,' said Kie Fo, 'is the watcher.'

"'What is he watching?'

"'To see that the aërostat always keeps lengthwise to the wind. He effects this with four cords; it is thus that in an open country, with a strong wind, we can land with little risk. Remark,' he added, 'that the first rope descending from the prow is almost vertical; it is the axis of rotation (or the stem of the weathercock), whilst the fourth rope represents the hypothenuse of a right-angled triangle, of which the mast forming one of the sides is always horizontal. The intermediate ropes are more especially intended to prevent the mast from bending, from the ascending force of the aërostat.'

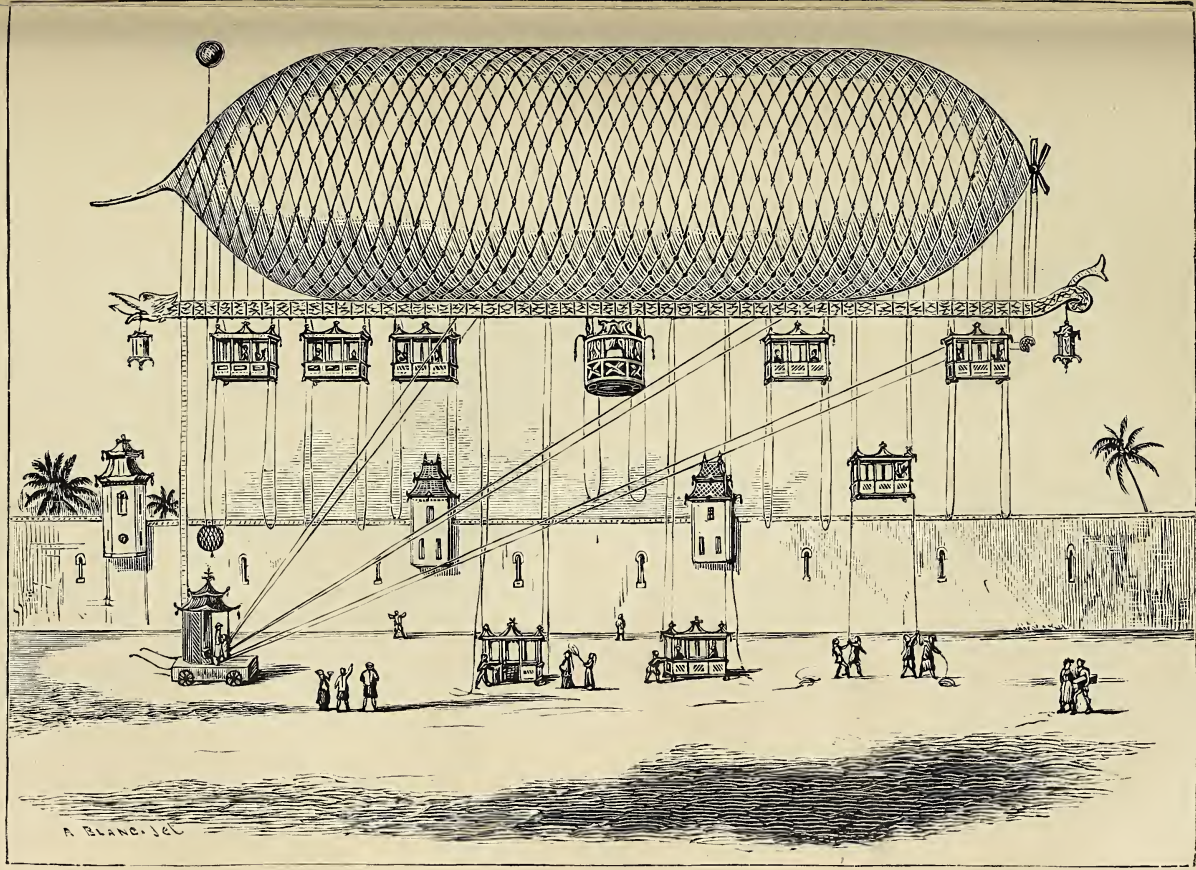
"The captain whistled, and the cars were lowered, each containing two seats. Two men who managed the machine first took their seats in the central cars. Two ladies were then admitted. We got into the second car from the prow, the first being occupied by the captain and lieutenant, whilst the car nearest the stern conveyed the master and his assistant. We were weighed, as each car must carry 160 kilogrammes (800 lbs.); the difference is made up by water being carried in the double bottom of the car. The total weight carried by the aërostat was 1600 kilogrammes, excluding car and tackle. This had to be equally distributed. We were then hoisted and made fast. After waiting a few minutes, to see whether any one was coming to occupy the vacant car, it was filled with water and hoisted also.

"'Our aërostat,' said Kie Fo, 'is the one that leads, and carries. Therefore, the captain and master; whilst the other carries the striker and the "sondeur" (or the carrier of the sounding lines).'

"'Will not our watcher also be wanted?'

"'No; he always remains thirty feet below us; his duty is to throw the anchor, and when the equipage reaches the ground he becomes the towing machine; he it is, also, who, at the signal from the captain, starts us.'

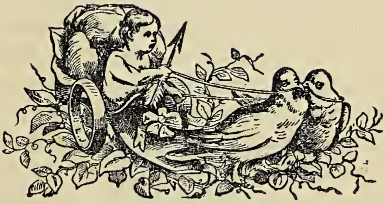
"I heard near my ear the movement of a rope, and saw one sliding along the mast. 'They are making the tackle fast,' said Kie Fo.




CHINESE AEROSTAT.

"A prolonged whistle from the rear balloon was answered by our captain to the watcher to 'let go.' We ascended rapidly several hundred feet, then moved in a horizontal direction. I shall not attempt to describe my feelings."

And so we will permit M. Dedreux and his mandarin friend to pursue their aërial voyage, confident that such an imaginary flight will result in injury to neither of them.



# CHAPTER XVI.

Treatise from the "Westminster Review"—Means of propulsion—Electro-magnetism and gun-cotton—Guide rope—Various methods of keeping balloons at a certain height—Friction of guide-rope applicable to steering—"Kedging."

THE following article on aërial navigation, from "The Westminster Review," is so comprehensive that we lay it before the reader without curtailment:

"The problem of aërial navigation is of course not completely resolved by the invention of a machine or apparatus capable of sustaining the human body in the air. It is necessary to discover, likewise, the means of guiding or propelling such a machine in any direction. It would, perhaps, at first sight, appear probable that if means of floating in the air be discovered, a method of propulsion could be readily found; yet it has proved in practice a far more difficult attempt than had at first been imagined, and the numerous schemes for effecting this object have all proved abortive, or been attended with success so insignificant as not to warrant the further prosecution of them. The balloon invented, the art of guiding or propelling it appears thus to be almost as far from our grasp, and as distant of attainment, as ever.

"Since the invention of the gas balloon by M. Charles, of Paris, but few improvements of importance have been made in it; and as might be foreseen from the original simplicity of the invention, what improvements have been made are not improvements in the principle, but in minor matters of detail. The most important improvement since introduced is one effected in the early part of the present century, by Mr. Green, well known for the many successful public ascents which he has since made. This improvement consists in the use of coal gas instead of pure hydrogen, which latter gas was employed in the ascents of M. Charles, and the subsequent ones of Lunardi, Garnerin and other aëronauts.

"One of the principal advantages arising from the employment of coal gas is economy, the saving of expense being very great; at the same time, from the greater density of the gas, its use entails this disadvantage, that the balloon is required to be of somewhat larger dimensions than when pure hydrogen is employed for inflation. The original

expense of construction is thus increased, but the disadvantage of the greater cost and size of the balloon is more than counterbalanced by the economy and convenience attending the use of coal gas ; and, what is of great importance, if balloons are eventually to become of practical utility, the period which a balloon retains its ascending power is considerably prolonged when coal gas is substituted for pure hydrogen.

"Since the introduction of the use of coal gas in aëronautics, but few, or rather, perhaps, we ought to say no, improvements in the construction of balloons have been made; minor improvements have indeed been made in the form and arrangements of some parts of the machine or apparatus connected with it, such as the ingenious method of liberating the balloon employed by Mr. Green, whom we have already mentioned; but these are all simple contrivances of detail which in no respect alter the principle of the machine.

"With the invention of the balloon, we had then obtained the means of floating in the air, and acquired possession of a contrivance for this purpose which, except its inability to support very great weights, left but little to be desired, when considered as destined merely to support the human body in the air and to move freely with the wind. But the employment of such a contrivance can scarcely be called aërial navigation; and, in fact, only half the work had been done; the ship for navigating the air had been invented: the art of sailing is still unknown. We can scarcely consider ourselves to have succeeded in discovering the art of aërial navigation until the aëronaut has at his command the means of varying the elevation of the balloon above the earth, and of causing it to move in any horizontal direction at will. Two methods of effecting this naturally suggest themselves; indeed, the art of aërial navigation may be considered (as that of ocean navigation now generally is) as divided into two great and distinct branches, the one comprising the manner of directing the machine by the agency of the wind itself in any direction, either coincident with or different from that of the wind; the other, the employment of artificial means of propulsion, such as propellers driven by steam-engines or machinery of a similar nature. Of the attainment of a practically useful method of propelling balloons by the motive-power of steam, we fear there is little hope; and were the attention of projectors directed to a method of sailing balloons, rather than propelling them, it is probable some useful practical progress might soon be made in the art of aërial navigation. Attempts at guiding balloons have indeed been made, but being ill directed, have always failed; and, in fact, the application of the steam-engine to locomotion not having been made at the time of the invention of balloons, all the early attempts at guiding balloons or increasing their speed were directed by the analogy, real or supposed, of a balloon and a sailing vessel. The supposed identity of the two cases led immediately to the trial of sails and rudders applied to balloons; the experimentalists, not perceiving the considerable and important difference existing between the two—a balloon and a ship—appear to

have fancied that the two cases differed merely in that of the balloon floating in a medium of far less density than water. The similarity of the two cases is, however, apparent rather than real. In the eagerness of the attempt, it was entirely overlooked that whilst the balloon, entirely surrounded by and immersed in the fluid which supports it, moves necessarily at the same rate as the current of air in which it happens to be, a vessel floating on the surface of the water is impelled by the force of the air, which, moving at a much greater velocity than any current, either in the river or the ocean, has, notwithstanding its much less density, sufficient power to give motion to the vessel. Sails and rudders, then, when applied to balloons, were found useless; the first did not increase the speed of the balloon, the second had no effect in guiding it. Sails were of course useless, since there was no wind to fill them, a balloon moving as fast as the wind; and for the same reason, there being no current, the rudder had no action on the direction of the motion.

"The more recent attempts made of late years have almost invariably been founded on schemes for propelling balloons, and in a great number of these the employment of the steam-engine is a principal feature. The objections to the employment of this motive-power, even if it should be found possible to avail ourselves of the force of steam for this purpose, would probably prove of such force as to prevent its introduction to any extent. It may, no doubt, be urged that in a medium of so small a density as air, the actual force required to propel a balloon would be very small, and that, this being the case, the size and weight of the machinery necessary to impel a balloon need not be very considerable, and that, therefore, it would be found possible to construct balloons of sufficient size and ascending power to carry the necessary machine. But were it even so, the necessity there would be of either relinquishing the use of the propeller after a very short period, or of descending to obtain supplies of fuel and water, would be found to render its practical application of but little value. If it also be remembered that to work a steam-engine it requires not only an engine and boiler, but a heavy weight of water and fuel, even if the engine work but for a very short time, and also engine men and stokers to work the machinery and feed the fires, the uselessness of the attempt is so evident as to render numerical calculations unnecessary for exposing its fallacy. The lightest form of marine steam-engine in use weighs about thirteen hundred weight per horse power; and when to this we add the weight of fuel and water contained in the boiler, and that of the men necessary for attending the machinery, we arrive at a sum total for the weight, whatever horse power we may assume as necessary, entirely beyond the power of any balloon to support. For though we may imagine a balloon of such vast dimensions as to be able to support such a weight, yet the construction of such a balloon would be difficult and its inflation almost impossible.

"But, hereafter, one means of obtaining motive-power may be dis-

covered which will enable us to dispense with the cumbersome appendage of a steam-boiler and the weight of fuel and water necessary for it. Electro-magnetism may, perhaps, stand us here in good stead, but at the present moment the discovery of gun-cotton offers, perhaps, the best hopes of ultimate success. The enormous force of this substance, compared with its weight and the space it occupies, the abolition of the boiler and all fuel which it will effect, and the fact of no water, either for feed or condensation, being required, are advantages which make us look forward to a trial of gun-cotton as offering a prospect of greater success than has hitherto attended attempts at balloon propulsion. Gun-cotton might be tried, probably with some effect, on the recoil principle of the rocket and the fumific impeller of Mr. Gordon, as well as with machinery similar to the ordinary steam-engine, such as has recently been patented by Mr. Talbot. The force of steam not being in this case applicable as a propelling power, if that of gun-cotton should not be found available, we must seek in another direction for a motive-power which with a small weight gives an intense force. The great object of the inventor will evidently be to get rid of a heavy encumbrance, such as a steam-boiler, and to confine his machine within the most narrow limits possible as to space and weight. The use of gun-cotton in lieu of steam would certainly reduce the size and weight of the machinery, as far as we can reasonably hope to reduce it. Our propelling machinery would then, in short, be a steam-engine working without water, without a boiler, and with but a very small weight of fuel; but until this substance has been successfully applied as a motive-power, its application to ballooning must, of course, be mere conjecture.

"There can be no doubt that if a motive-power fit for the purpose could be found, some form of propeller would soon be invented capable of applying this power with good effect in the propulsion of balloons. The numerous experiments which have been made during the last few years with submerged propellers applied to steam vessels make it certain that a similar form of propeller might be used for balloons, with a fair chance of a successful result, if only a moderate velocity be required. We have ourselves seen a model balloon, furnished with a screw propeller, operated by clock-work, perform in a satisfactory manner in a small room, the air being still. The employment of a propelling power applied to the car of a balloon would, however, experience a difficulty of a peculiar nature, which presents itself in all balloon experiments; this is a constant though slow rotation of a balloon round its vertical axis. The use of the guide-rope, which we shall presently describe, almost, if not entirely, destroys the tendency to rotation; but one effect of the guide-rope is to retard the motion of the balloon, while the object of the employment of a propelling force is, of course, to increase the velocity of the balloon, so that the contemporaneous employment of the propelling force and the guide-rope is scarcely feasible; but until, by some alteration in the form of balloons or by the application of

some mechanical contrivance destined to effect this, the tendency of a balloon to rotate round its vertical axis be destroyed, the application of propelling machinery to balloons can be followed but by little or no useful effect.

"The want of success attending the early attempts at guiding balloons appears to have deterred adventurers from repeating these experiments or devising new methods for effecting this object, and since the beginning of the present century nothing of practical utility has been tried. However, Mr. C. Green, whom we have already had occasion to mention, has broached an idea which appears to be in the right direction, and which will, possibly, when modified, be found to be feasible. Mr. Green, having remarked, during his numerous balloon voyages, that at various heights above the earth he met with currents of air which carried him in a direction different from that in which the wind was blowing at the time of starting, conceived the idea, if it be possible to keep a balloon at a constant elevation above the surface of the earth, that advantage might be taken of this circumstance, for by increasing or diminishing the altitude of the balloon a current of air might be found to carry the aëronaut in any direction he might desire. It has, indeed, been long known that the wind observed at the surface of the earth does not blow in the same direction with the current of air moving at some distance from the earth. This phenomenon occurs not only in our latitudes, but also in the regions of the trade-winds; and several observers, amongst them Sir James Ross in his recent voyage, have noticed, when in the trades, small clouds moving at a considerable height above the sea in a direction contrary to that of the trade-winds. It is obvious that if it be true that, at some height or other above the earth, we may find a wind blowing in any given direction, and supposing we can cause the balloon to remain invariably at the same height, we might be enabled to move a balloon in any direction merely by ascending or descending until a current of air having the required direction is met with.

"Various methods of causing the balloon to remain at an invariable height may doubtless be supposed, but the one actually in use—namely, that of discharging gas or ballast according as it may be necessary to check a tendency of the balloon to rise or fall—is of very limited application, for the quantity of ballast and gas which can be employed in this manner is very small. The power of varying the elevation or remaining at the same height would be greatly extended by the use of condensed or liquefied gas. A small receiver containing liquid coal gas might be taken up in the car; and being connected with the balloon by a tube and stopcock, the aëronaut would be able by the simple opening of the stopcock to permit the entrance into the balloon of a large quantity of gas. There would undoubtedly be a few practical difficulties in its application, but none such as could not be readily overcome; but the danger attending the use of gas in this form is but slight, liquefied gas having been in com-

mon use for some years past for lighting apartments and railway carriages in France.

"Mr. Green, however, proposes Mr. Baldwin's method, which is very different from the above. He supposes the aëronaut furnished with a rope of sufficient length to reach from the balloon when in the desired current of air to the earth, one portion of the rope resting on and trailing along the surface of the earth or sea, as the case may be, while the other end is attached to the balloon or car. If the balloon, from the effect of the sun's rays on it, rise to a greater elevation, a corresponding length of rope will be raised off the surface of the ground and supported in the air, and in the same way, if the balloon sink, an additional length of rope will be plunged in the water or drag along the earth. The result will be that in the one case the same effect will be produced as if an additional quantity of ballast were added to, or a small volume of gas allowed to escape from, the balloon; in the other, the effect will be similar to that of the discharge of ballast from the balloon. It is evident that by this contrivance the balloon will remain at nearly the same height from the ground, the effect of any expansion or contraction of the gas created by increase or decrease of the temperature of the surrounding air being counteracted by the alteration in the weight which the balloon has to support, and that without any loss of either ballast or gas. This method, however, could scarcely be practicable, except at sea, on account of the damage and difficulty its employment would occasion by the entanglement of the rope in trees and buildings; but at sea no difficulty arising from these circumstances could be experienced, and the experiment is certainly well worth a trial. At great elevations above the earth the weight of the rope would also become so considerable as to require for its support a large portion of the ascending power of any balloon.

"One thing is clear—that the friction of the rope on the earth or in the water would occasion a degree of resistance sufficient to retard in some degree the speed of the balloon, and this would lead us to hope that, this plan being adopted, it would be found possible to guide or steer balloons. We have already observed that to guide or steer balloons it will be necessary to find out some method of creating a relative velocity between the balloon and the wind which impels it; in other words, we must arrange matters so that the balloon move either slower or more rapidly than the wind. Now, this is effected by the proposed guide-rope of Mr. Green, and we may observe that sailors are sometimes compelled to resort to a similar artifice in order to obtain steerage-way on a vessel.

"This artifice in navigation is termed 'kedging,' and is employed when vessels are floating down streams or rivers when there is no wind. Under such circumstances a vessel would be in constant danger of being run on shore, unless steerage-way could be got on the vessel. This is effected in the following manner: It is well known that an anchor holds the ground more or less firmly according as its

distance from the vessel is greater or less, and when the anchor is immediately under the ship's bow it has very little or no hold. Now, supposing a vessel be in a tide-way with no sails set to obtain steerage-way, the anchor is allowed to trail along the ground under the bows of the vessel, the cable being hove down until nearly vertical, and the resistance thus opposed to the motion of the vessel through the water sufficiently great to enable the vessel to be steered.

"The artifice above briefly described evidently bears a striking resemblance to the guide-rope of Mr. Green, and we think that an attempt at steering balloons made in conjunction with the use of the guide-rope would be successful. Of course some practical difficulties would be found to exist, and the form and arrangement of the steering apparatus would be a subject for careful consideration. Some difficulty would also be met with from the rotation of the balloon on its vertical axis.

"At sea, where this idea holds out great hopes of success, the lower end of the guide-rope should be attached to a small boat or float, which would increase the resistance and give additional steerage-way.

"The difficulties of steering balloons would then be found, we think, to be far from insuperable. The rotation of a balloon about its vertical axis would likewise be found a considerable obstacle to the use of any propelling power, since the rotary motion of the balloon would cause the direction of the propelling force to change at each instant. A balloon always rotates in this manner, but its rotation is slow, and the fact is not at once perceptible, and only apparent on regarding fixedly an object, such as a cloud, at some distance from the spectator, when the position of the observer is soon found to change. It is possible that were a form other than the spherical one usually adopted given to a balloon, this motion of rotation might be very much diminished, if not altogether avoided."

## CHAPTER XVII.

Rotation of balloons considered—Shape of balloons—Their navigation demonstrable—Method set forth—Facility of crossing the Atlantic—Effect of experiment considered—Air and water craft—California air-steamer—Comments on it—"Difficulty of aërial navigation"—Pro and con—Its dangers considered.

THE preceding account seems to cover the whole ground of the theory of balloon sailing and balloon steering. The value of its ideas and suggestions is enhanced by the fact that what it contemplates as serious obstacles to the perfection of balloon navigation are to the practical aëronaut but minor difficulties. The rotary motion of the balloon while sailing quiescently in the air-current is the effect of so slight a cause that, under the present system of aëronautics, it presents no formidable obstacle to the perfection of aërial navigation. This rotation is attributable to two causes—the shape of the balloon and the undulatory motion of the air-currents. The position of the balloon when floating in the air-current, while it is in equilibrio with the surrounding atmosphere, may be justly compared, in regard to its motion round its vertical axes, to a similar shaped vessel with a string fastened to its upper axes and suspended from the ceiling of a room. In the latter case the vessel should have gravity enough to merely hang down in order properly to illustrate the question. It will thus be perceived how very slight must be the wave of atmosphere to put it in motion, poised as it is, in either case, upon its centre of gravity. In the case of the suspended vessel it would have to overcome the friction of the string by which it was hanging, and would consequently require more force to make it vibrate on its axes than it would with the balloon, which, while sailing free in the air, would not have to encounter that part of the friction. Now, it is evident that the effect of so slight a cause as that which gives rotary motion to a balloon would be entirely neutralized by any propelling force that would move it faster than the air-current, as, in such case, there must necessarily be a rudder which would keep the machine *fore and aft* with its line of direction, the same as a steamboat or ship would be when propelled along, and faster than the current in which either of them

might be sailing. We have, while sailing in the air-current, reversed the motion of the balloon round its vertical axes by simply using a palm-leaf fan. There is, however, connected with this part of the subject another circumstance worthy of consideration. It is while the balloon is ascending and descending from one current into another. In such case the effect of rotation and counter rotation is of course more violent than when the balloon is sailing quiescently in the air-current, and it is similar to that which a ship experiences when sailing through a bay and coming suddenly across a current dashing down a river into the bay. But even this circumstance presents no greater barrier to the management of a balloon while being propelled by the aid of artificial motive-power than does the case just mentioned to the ship's management.

It has been demonstrated that a balloon of a spheroidal shape, moving forward with its longer axes in a horizontal position, and propelled by a motive-power applied to windmill-shaped wheels, is not liable to be much disturbed by a tendency to rotary motion. And even a globular-shaped balloon would be free from such disturbance when propelled forward and having a rudder to guide it. But of course an oblong shape—which comes nearer the shape of a bird or a fish—is best adapted to the principle of steering or guiding, while the globular shape, on the other hand, is best adapted to the method of seeking the air-currents which are to waft it to its destination. Here are two principles by which aërial navigation may be accomplished in a useful manner. By a combination of the two principles, it is within the present known province of mechanical contrivance, and requires nothing more than the effort to put it in motion. While on this subject let us consider the means of its consummation. A balloon fifty by a hundred feet, of a spheroidal shape, would be capable of carrying 6000 pounds, independent of its own weight and a due allowance for expansion of the gas. This would enable us to carry a car supplied with an engine to be worked with gun-cotton sufficiently powerful to propel the balloon with a speed of eighty miles per hour in a calm atmosphere, forty miles per hour against a wind of a velocity of forty miles per hour, and so on in the same ratio against winds of greater or lesser velocities. In addition to the engine, wheels and rudder, the balloon would be capable of carrying from 1500 to 2000 pounds of ballast. Now, with an aërial ship thus provided, I would have no more hesitation to undertake a trip across the Atlantic Ocean than to embark for that destination in the most approved steamship plying between the ports of New York and Liverpool. Indeed, the engine would only be required to make steerage-way, so as to make the *exact* point of destination; for the main part of the voyage may be certainly accomplished by seeking the proper currents that will waft the vessel in its destined direction. The engine could be, moreover, employed as a means of elevating or lowering the balloon, by having a screw wheel adapted to that purpose, and by such means enable us to seek the proper or

most advantageous current without expending any gas or ballast while in search of it.

Now, an experiment of this kind is really wanted. It is wanted for two important reasons; one is to demonstrate positively and in reality that aërial navigation is so far practicable as to enable us to sail from New York to Liverpool with a balloon, and that, too, in less than half the time it requires the best ocean steamers to accomplish the same. The other reason is to draw the attention of the community at large toward the improvement of the art, which will follow just as surely as the experiment will be accomplished.

Steam, the agent which has revolutionized the moral and commercial world within the present century, would, in all human probability, be to this day yet what it was in the hands of Savary and Newcomen, had not a Fulton demonstrated its utility by actually building a steamboat and propelling it up the Hudson River at the rate of four miles per hour. So with aërial navigation: something more than mere theorizing and simple ascents with balloons is wanting to bring it to that state of perfection which art, science and the genius of our race require of it. So far, however, our modern projectors of aërial machinery all seem to have overstepped the mark. The few who have actually been engaged in it have rather attempted too much, and therefore failed in their designs, instead of doing what was within their reach, and thereby establishing that confidence in the community which is so necessary to the attainment of a high perfection in anything that concerns the general welfare of a nation. Miscarriages in projects connected with an advancing art are more detrimental to its progress than if no experiments were made at all; while, on the other hand, success in an experiment which gives the slightest evidence of improvement is generally followed by rapidly-increasing accessions. On this account it were better if the friends and promoters of this art would confine their experiments within the range of what is more certain of success than to overleap the expectation of moderate advance, and thereby lose the time and labor devoted to the subject, which in the end brings distrust instead of encouragement.

In attempting too much we do not simply run the risk of being defeated in the end, but we also bring down upon the projects in such cases theoretical demonstrations from scientific sources that are strongly detrimental to a vigorous pursuit of the subject. Such has been the case in regard to projects lately suggested in some of our large cities, concerning aërial navigation. Not many years ago it was proposed in the city of New York to form a company to navigate the Hudson River between the above-named city and Albany by a combination of water and air craft machinery. It was to consist of a balloon and a steamboat. The balloon was to be oblong or spindle shaped, of the same length as the steamboat, and was to be of such power as to buoy up a less weight than the boat: so much less as to let the boat draw water sufficient to make her steerable, and for her propelling wheels to take effect in

the water. Thus combined, the steamboat hanging underneath the balloon, drawing very little water, and the wheels in rapid motion, it was to go up or down the North River with a velocity of not less than a hundred miles per hour.

Now, all this appeared very feasible and interesting in theory, and a great many sensible people believed it would go into operation, but to the practical mind it at once proved its own futility. In a calm atmosphere, and on a straight river, this might be done; but in the ordinary and natural requirements of transportation and its circumstances, it promised no usefulness, nor even experimental success.

In later times and in the same place, when half the population of our country was infatuated with the gold romance of California, it was proposed to build a balloon with which to carry passengers to the gold regions of California at the rate of two hundred miles per hour. A model of the machine was exhibited in New York and in Philadelphia. It was simply a spheroidal or spindle-shaped balloon, rigged with a pair of propeller wheels and rudder, and a steam-engine for propelling power. The exhibition of this model created a considerable sensation in the minds of the credulous, and it was asserted at the time that many persons engaged passage in the contemplated "aërial steamer." Whether it was seriously intended by these projectors to build one on a large scale, time, thus far, has not yet positively developed; although it was stated in a respectable journal of New York city, in the year 1849, that the machine was actually in course of construction and the steam-engine was finished.

Had these projectors gone on from their miniature model to the erection of one capable of carrying one or two persons, in order to prove its practicability on a larger scale, there might have been reason to believe that they harbored an idea of its general usefulness. But when the project embraced at once so magnificent a scheme as that contemplated in the swooping strides toward the modern *El Dorado* with a cargo of a hundred gold-hunters, it seemed too much for sober-minded people. And as we stated before, it brought upon itself philosophical criticism and scientific condemnation, and with that a good share of opposition to the hopes and expectations of aërial navigation in any shape.

The "Scientific American," one of the best journals of its kind then existing in the country, published in the city of New York, made frequent allusions to the subject of aërial navigation, as well as to all matters connected with the progress of the material world, and from the assumptions contemplated in the California project just mentioned published the following article under the head of "The Difficulty of Navigating the Air." It says:

"No body can float in the air unless it be 800 times lighter than water; such a body, therefore, must of course carry 800 times less power than might be used in a steamboat. But the utmost power that a steamboat can carry will not enable it to make the least headway

against wind blowing 200 miles per hour. How, then, is it possible for a body of 800 times less power to make any headway against even a wind blowing three miles an hour?

"In navigating the air, we can obtain no fulcrum but the air itself, and that is yielding, and but a small portion of even the power which can be carried could prove effective.

"If a body so comparatively solid as water causes a loss of power, the loss must be vastly greater in a body 800 times lighter and exceedingly elastic. When to all this we add 800 times less power than a steamboat, and at the same time bear in mind the further fact that a steamboat cannot make the least headway against wind blowing 200 miles an hour, it is no go."

Seeing the effect of such reasoning, coming, as it did, from a purely scientific and highly respectable journal, the author of this work, as an ardent laborer in the cause of improvement, felt it his duty to notice the above hypothesis in the following brief manner:

"GENTLEMEN: In the second number of the present volume of your journal you have an article under the head of 'The Difficulty of Navigating the Air.' In it you correctly assume that a body must be 800 times lighter than water before it can float in the air, and that such a body, therefore, must carry 800 times less power than a steamboat. You then go on to state that a steamboat cannot make any headway against a wind blowing two hundred miles per hour. Granted. The part of the boat above the water is opposed by the wind; the part below, or in the water, is against the opposing current of water caused by the wind, which is much more opposing than the wind would be of itself if blowing against the hull of the boat directly. In the case of the water acted on by the wind, it is an *accumulating* force, increased by the duration of the blast and extent of its impact upon the water. But it is even so as you have stated. You then say, 'How is it possible for a body of 800 times less power to make any headway against even a gentle breeze blowing three miles an hour?' And from the whole calculation you make in the aforesaid article, you conclude that aërial navigation 'is no go.'

"Your paper is intended to promote the arts and sciences, and your opinion on any subject, being its editor, carries with it weight, and should, therefore, be open to a fair analysis. Now, if your premises in the question were firm and invariable, the conclusions could hardly be shaken. Your hurricane would, indeed, blow all aërial machinery its own way with a velocity *exactly* equal to its own (I have experienced this), and it would, moreover, wreck and founder any ship or steamboat in the water caught in its track. Not so, however, with aërial machinery. The air-craft has but one medium, the water-craft has two; hence the latter's destruction, arising from the great disparity of density in the two mediums, and the former's safety from moving in the simple element. Such a wind, so far from injuring a balloon, would only drive it completely round the world in five days, if it con-

tinued that long. Now, the aërial ship has an advantage, compared with the water ship, that is seldom considered. It can *surmount* or *dodge* the 'no go' barriers in your premises—the steamboat can't. It is not necessary, in aërial navigation, to go right against the wind; nature is very profuse in its variety of atmospherical currents within two miles above the level of the sea. The greatest obstacle to the perfection of aërial navigation is in the loss of buoyant power required in rising and falling into the currents that will waft the vessel toward its port of destination. I am not theorizing when I say that nature is profuse in its variety of currents; I know it from the experience of over a hundred aërial excursions. By the aid of these contrary and various currents I have avoided the necessity of descending into rivers, forests, lakes, seas and bays. The uppermost current I have always found to blow from west to east. While aloft I have, within the *visible* length of a twine string suspended from the car, seen the effects of two currents besides the one that moved the balloon. These strings were 500 feet long. You may often see, as you no doubt have seen, two, three and four different currents of air within the range of the cloud region when clouds exist. I have found these various currents just as numerous in a perfectly clear atmosphere. The greatest desideratum in aërial navigation is a power adaptable to raising and lowering the balloon without expending any of its buoyant gas. Steam, I think, is not adaptable to its being made a *common* useful art—it would do for a demonstrable purpose—but the progress of improvement may yet give us a power-agent adaptable to this art, if we should fail to contrive a means by which a balloon may be made to rise and fall by the principle of expansion and contraction.

"Franklin said the child must learn to walk before it can run, in allusion to aëronautics; and as this child lay in the womb of science over two thousand years before it was born (it was sought after all that time by many ingenious persons), it is certainly doing very well, considering its infant state. A subject like this, calculated, when perfected, to bring within the space of a few weeks the practicability of exploring the whole circumference of the globe, must have its time. That time is fast approaching; but it wants encouragement, especially by the developing powers—the scientific press.

"The natural elements, so far from presenting barriers and obstacles, as they do to a great extent in ocean navigation, seem to be peculiarly inviting to aërial navigation. The almost universal opinion, and to a great extent among really scientific men, that aërial navigation cannot be turned to a generally useful account, is almost as prevalent as the opinion that aërial voyages are extremely dangerous, and is just as wrongly founded, in my humble opinion."

The foregoing article was published in the New York "Scientific American," and elicited the following complimentary notice:

"The above communication from Mr. Wise is just such a one as we like. It is reasonable, and contains practical information. His opin-

ions respecting steam as an aërial propellant accord with our own, and as we have expressed them on the subject in our last volume. There is another thing besides the discovery of a more compact power which would greatly facilitate economical balloon navigation—namely, a more buoyant, cheaper gas than hydrogen. A body of great magnitude is not easily managed: the whole experience of ballooning proves this. We all know that balloons can ascend, float and move in the atmosphere, and have been propelled by the Roberts, in Paris. These things are not the subject of discussion. It is the practicability of propelling balloons through the atmosphere as steam vessels on the ocean. There is no man to whom we can more confidently look for a correct solution of the question of aërial navigation than Mr. Wise.

"As it respects the last paragraph of the above letter, we must say that the whole history of ballooning, to scientific men, is full of facts affording just grounds for their opinion—that is, respecting its danger. Within the past three months one aërial navigator lost his life in England; Vardalle barely escaped with his in our city; and it was certainly a most wonderful escape of the celebrated Mr. Green in one of his late ascents in London. The subject of aërial navigation has been before the scientific world for sixty-seven years, and we know of no practical improvements that have been made in it since the days of the French Consulate; while during that period steam navigation and the science of electricity, and other sciences, have advanced with giant strides; yet for all this we never have and never will ridicule experiments in aërial navigation. We have hopes like those of our correspondent; but so far as it regarded the balloon excitement that was raised about going to California at the rate of two hundred miles per hour, we deemed it our duty to expose the sham, although believed by thousands, and the results have faithfully borne us out in our predictions—yea, in every word."

Now, concerning the danger of ballooning, we still say there is no just ground for its apprehension. In reference to the cases just mentioned, it should be recollected that the one which proved fatal to the aëronaut in England was more from the cause of imprudence than the intrinsic peril of ballooning. The balloon and aëronaut were both drifted on to the beach soon after their descent, thus showing that if the individual had trusted himself to the aid of the machinery, instead of, as may be reasonably supposed he did, swimming to shore, his life would have been saved. In the case of Vardalle, it must be remembered that he used a rarefied-air balloon—a contrivance long ago abandoned by scientific men on account of its inutility. As to the case of Mr. Green, it is of a kind that has so frequently happened to aëronauts without any serious consequences that it is scarcely to be counted a peril. If we had not the mathematical science of the art to prove that it is as simple and as safe as any other mode of travel or conveyance, the result of many hundred voyages would indubitably establish the truth of what has been said of its safety.

# CHAPTER XVIII.

Letter from the veteran aëronaut Green—Great aëronautical expedition from London to Weilburg across the sea, made by Robert Holland, Esq., Monck Mason, Esq., and Charles Green, aëronaut—Written by Monck Mason.

DURING the early part of the fall of 1849, when I had determined to complete this work, I wrote to the veteran aëronaut Mr. Charles Green, of London, for an account of his voyage from the English metropolis to Germany, as I had failed to find it in our libraries. Just as the book was being finished for the press, I was fortunate enough in getting from that gentleman a package enclosing the account written for, as well as several other papers too valuable to be omitted. To show the lively interest this celebrated aërial navigator exhibited in the art, a part of his letter may be quoted:

"HIGHGATE, Dec. 7, 1849.

"MR. JOHN WISE:

"ESTEEMED SIR: Having only this day returned from the Continent, your favor has just come to hand, which I much regret, as I fear this will reach you too late to be of service for your work.

"Herewith you will receive the only copy I have of the trip to Germany; likewise all I can lay my hand on relative to Mr. Cocking's fatal parachute descent. I have a numerous collection of articles on aërostation, with many duplicates, some of which, in the event of your having a second edition of your work, might be of service, but which at present are much confused and mislaid by my preparations for removal to a new residence after Christmas.

"I am convinced much may be done by aid of the propellers, not only by causing the balloon to ascend or descend without discharging gas or ballast, but in varying its direction in a tranquil atmosphere, which I have often experienced within a mile of the earth during the prevalence of a strong wind at its surface.

"I likewise consider a guide-line of gutta-percha, with compensating appendages, as used by me for land or water, indispensably necessary to the performance of long voyages.

"The accident you allude to was in a great measure a newspaper affair, which arose from my assistant suffering the escape of too much

gas as it expanded in the ascent, the balloon being quite distended on leaving the earth.

"I am, esteemed sir, your sincere well-wisher,

"CHARLES GREEN."

The following is the account of the voyage from London to Weilburg, in Germany, in the Vauxhall balloon, afterward called the "Great Nassau," written by Monck Mason, Esq. The notes are Mr. Mason's:

"PARIS, Dec., 1836.

"The interest with which the public at all times appear to have regarded the progress of aërostation, and especially the very flattering concern which they have deigned so unequivocally to express for the successful issue of our late undertaking, have concurred in inducing me to abandon the usual path of communication hitherto adopted upon such occasions, and confirm me in the opinion that some account, more accurate and detailed than is generally to be found in the columns of the public press, might not prove unacceptable to those for whose sympathy and consideration we can never acknowledge ourselves sufficiently grateful. In this belief, which I hope may not be deemed fallacious, I have seized the first vacant moment since our descent to embody in the present form all those incidents and observations to which a voyage so singular is so amply calculated to give rise. It is true that many of these have already reached the public ear through the medium of the public press, while at the same time, no doubt, much of the interest which owes its origin to the uncertainty and supposed peril of such exploits must have already subsided in the knowledge of the result and of the leading features which our duty to the public made it imperative upon us immediately to divulge. It is not, however, in the mere issue, successful or unsuccessful, that the chief merit or importance of such an enterprise can alone be said to consist. Designed with a view to special ends, and undertaken for the sole purpose of ascertaining and establishing the efficacy of certain improvements in the art, from which most beneficial results *were*, and I am now happy to add *are*, most likely to accrue, it becomes no less an obligation to ourselves than to the world in general to make them partakers in the knowledge of whatever interesting or important circumstances either accompanied the progress of our expedition, or may justly be expected to attend the adoption of those improvements the merits of which it was our sole object in the present instance to confirm.

"From the time of the first discovery of the properties and power of the balloon, up to a late period (already a lapse of more than half a century), a variety of obstacles apparently insurmountable continued to obstruct the progress and paralyze the efforts of all who sought to render it obedient to the sway of human will and subservient to the purposes of human life. The chief of these impediments consisted in

the uncertainty and expense attending the process of inflation, from the employment of hydrogen gas; the dangers considered inseparable from the practice of the art; the difficulties which hitherto have baffled all attempts to give a direction to the ungovernable mass; and the impossibility which all previous aëronauts have experienced of remaining in the air a sufficient time to ensure the attainment of a sufficient distance.

"To remove these obstacles and reduce the aërial vehicle to a more certain issue, a vast amount of actual experience, united to an intellect capable of turning it to a proper account, was absolutely required; and it would be an act of much injustice were I not to declare that it is to the combination of both these, in the person of Mr. Charles Green, that we are indebted for the entire results of all that is beneficial in the practice or novel in the theory of this the most delightful and sublime of all sublunary enjoyments.

"It was to him and to his discovery of the applicability of coal gas to the purposes of inflation that we owe the removal of the first of those impediments in practice, which till then had continued to weigh down with a leaden hand the efforts of the most indefatigable and expert, and had in fact bid fair to quench the incipient science in its very onset.

"Up to the period of that discovery, the process of inflation was one the expense of which was only to be equalled by its uncertainty; two, and sometimes even three, days of watchful anxiety have been expended in the vain endeavors to procure a sufficiency of hydrogen to fill a balloon, from which, on account of its peculiar affinities, it continued to escape almost as fast as it was generated; during all this time the various casualties of wind and weather, the inevitable imperfections of a vast and cumbrous apparatus, and above all the enormous expense attending this operation, were to be incurred and endured for the sole purpose and with the sole object of remaining for a few hours helplessly suspended in the air. Under such disadvantages, all prospect of advancement in the art had speedily disappeared, and it was only by the timely intervention of Mr. Green's ingenious application that the art itself was saved from a premature extinction; aërostation had gone to sleep, when, roused by this discovery, she awoke to redoubled efforts and rendered that, in the hands of the *skilful*, a profession and a profit which before had ever been a matter of doubt, difficulty and distress.*

"With respect to the next of those impediments which in the opin-

* Independent of the diminution of expense and risk from the employment of coal gas in preference to hydrogen for the purpose of inflation, there are other advantages of great importance, one of which merits special notice. I allude to the superior facility with which the latter is retained in the balloon, owing to the greater subtility of the particles of hydrogen and the strong affinity which they exhibit for those of the surrounding atmosphere. In a balloon sufficiently perfect to retain its contents of coal gas unaltered in quality or amount for the space of six months, an equal quantity of hydrogen could not be maintained in equal purity for an equal number of weeks.

ion of mankind might have continued to oppose the adoption of aërostation as an organ of general utility—I mean the danger usually considered as consequent upon the exercise of the art—little is required to prove the fallacy of such fears; two hundred and twenty-six ascents,* undertaken at all periods of the year, without one disappointment to the public, and without one solitary instance of fatal consequences, or even of an accident of disagreeable results (except from the intervention of malice),† ought to be a sufficient proof of how little danger is to be apprehended in the practice of aërostation, when under the management of a skilful leader, and with the aid of those improvements to which his experience has given rise. It is not from the bungling efforts of unqualified persons that any judgment should be formed on this or other matters of practical detail; and where that skill is present without which no one has a right to expect success, and those precautions have been observed which experience has shown to be requisite, I do not hesitate to say that the practice of aërostation is as devoid of extraordinary danger as that of any other mode of conveyance hitherto adopted.‡

"Great, however, as are the merits of Mr. Green's previous discoveries, they may be said to yield in importance to that whereby he has succeeded in enabling the aëronaut to maintain the power of his balloon undiminished during the continuance of the most protracted voyage it could ever be required to perform. In order fully to comprehend the value of this discovery, which more immediately formed the object of our late enterprise, it is necessary that some idea should be had of the difficulties it was intended to obviate, and of the effects they were calculated to produce upon the further progress of aërostation. When a balloon ascends to navigate the atmosphere, independent of the loss of power occasioned by its own imperfections, an incessant waste of its resources in gas and ballast becomes the inevitable conse-

* The number of Mr. Green's public ascents up to the present period.

† In an ascent from Cheltenham, a few years ago, in which Mr. Green was accompanied by Mr. Griffiths, some malicious scoundrel contrived to sever the ropes of the car in such a manner as not to be perceived before the balloon had reached a considerable elevation, whereby the parties were precipitated to the ground, and very narrowly escaped destruction. Neither the author of this premeditated villainy nor the design it was intended to answer has ever yet been discovered, although a reward of one hundred guineas was immediately offered for his detection.

‡ It will be observed that no reference is here made to the state of the art in respect of the power of guiding the balloon according to a given direction, the want of which is generally considered as the most effectual obstacle to its further progress and adaptation to the ordinary purposes of human life. As the discussion, however, of this question would tend to a considerable digression, and as it likewise formed no part of the project in pursuance of which our late expedition was undertaken, I have thought it preferable to omit all mention of it for the present, reserving for a future opportunity a more elaborate investigation of the case than would be here either consistent or agreeable.

quence of its situation. No sooner has it quitted the earth, than it is immediately subjected to the influence of a variety of circumstances tending to create a difference in its weight, augmenting or diminishing, as the case may be, the power by the means of which it is supported. The deposition or evaporation of humidity to the extent, in proportion to its size, of several hundred weight, the alternate heating and cooling of its gaseous contents by the remotion or interposition of clouds between the object itself and the influence of the solar rays, with a variety of other more secret though not less powerful agencies, all so combine to destroy the equilibrium which it is the main object of the aëronaut to preserve that scarcely a moment passes without some call for his interposition, either to check the descent of the balloon by the rejection of ballast, or to control its ascent by the proportionate discharge of gas—a process by which, it is unnecessary to observe, the whole power of the balloon, however great its dimensions, must in time be exhausted, and sooner or later terminate its career by succumbing to the laws of terrestrial gravitation. By the simple contrivance of a rope of the requisite magnitude and extent, trailing on the ground beneath (and if over the sea with a sufficient quantity of liquid ballast contained in vessels floating on its surface), have all these difficulties been overcome, and all the features of the art completely and effectually reversed. Harnessed to the earth or ocean by a power too great for her to resist, it is in vain the balloon endeavors to change the level of her onward course; every foot she would have been otherwise compelled to add to her elevation now only adds to her weight, by her endeavors to abstract from the earth a further portion of that rope which is dependent upon its surface; while, on the other hand, every foot she would have been inclined to descend, had she been at liberty, as heretofore, now only abstracts from the weight which draws her downward, by throwing on the earth the labor of supporting an additional portion of the guide-rope, which she would otherwise have had to sustain without relief. Limited to one unalterable plane, all the fluctuations above mentioned, whereby her irreparable stock of power became subjected to incessant waste, have thus completely been avoided, and not only her ascensive force maintained in its full vigor throughout a period determinable solely by her own imperfections, but at all times and under all circumstances, over the boundless ocean without a landmark, in the densest fog and throughout the darkest night, the exact direction of her course, as well as the very rate of her progress, determined with the utmost facility and most infallible results.* The main feature how-

* The progress of the guide-rope being delayed to a certain extent by its motion over the more solid plane of the earth's surface, while the movement of the balloon is as freely as ever controlled by the propelling action of the wind, it is evident that the direction of the latter, when in progress, must ever be in advance of the former; a comparison therefore of the relative positions of these two objects by means of the compass must at all times indicate the exact direction of her course; while with equal certainty an estimate can at once be obtained of the

ever, in this discovery, is the altered aspect under which it enables the aëronaut to regard the perils of the sea, and the consequent extension it bestows upon the hitherto limited sphere of his relations. The ocean, now no longer the dreaded enemy of the aërial voyager, becomes at once his greatest friend, and instead of opposing his progress offers him advantages more certain and efficacious than even the earth itself, with all its presumed security, is calculated to contribute.

"Such, then, was the actual state of aërostation when Mr. Robert Holland, a gentleman who had long cultivated a practical acquaintance with the art, resolved to afford an opportunity for a full display and unequivocal determination of the merits of these discoveries by undertaking at his own expense to fit out an expedition, under the guidance of Mr. Green (in which he was so kind as to include me), for the purpose and with the intention of starting from London, and proceeding (in whatever direction the winds at that time prevailing might happen to convey us) to such a distance as would suffice to answer the ends for which the voyage was especially designed. Accordingly, the proprietors, Messrs. Gye and Hughes, having kindly conceded the use of the great Vauxhall balloon and of their premises for the purpose of the ascent, after several unavoidable delays, occasioned chiefly by the weather, the day of departure was fixed for Monday, November 7, 1836; and the process of inflation having been commenced at an early hour, everything was got ready for starting by one o'clock in the afternoon of the same day.

"The appearance which the balloon exhibited previous to the ascent was no less interesting than strange. Provisions, which had been calculated for a fortnight's consumption in case of emergency, ballast to the amount of upwards of a ton in weight, disposed in bags of different sizes, duly registered and marked, together with an unusual supply of cordage, implements and other accessories to an aërial excursion, occupied the bottom of the car; while all around the hoop, and elsewhere appended, hung cloaks, carpet-bags, barrels of wood and copper, coffee-warmer,* barometers, telescopes, lamps, wine jars and spirit flasks,

velocity with which she is proceeding, by observing the angle formed by the guide-rope and the vertical axis of the machine. In proportion as this angle enlarges an increase in the rate of the balloon may be infallibly inferred; and, vice versa, its diminution will be found to correspond exactly with the diminished velocity of her advance. When the rope is dependent perpendicularly, no angle of course is formed, and the machine may be considered as perfectly stationary, or at least endowed with a rate of motion too insignificant to be either appreciable or important.

*A machine had been contrived for the purpose of warming coffee and other liquors, without the intervention of fire, by the means of slaked lime, which answered the purpose sufficiently well, although the danger which it was intended by these precautions to avoid is really not such as to require the aid of such appliances; with that degree of prudence and attention which can at all times be commanded, no real peril is to be apprehended from the use of actual fire. During

with many other articles designed to serve the purposes of a voyage to regions where, once forgotten, nothing could be again supplied.

"Among the other matters with which we had taken the precaution to provide ourselves were passports directed to all parts of the Continent, specifying the peculiar nature of our voyage, and entitling us to exemption from the usual formalities of office.

"In addition to these, we were also charged with a letter to his Majesty the king of Holland, from Mr. May, his Majesty's Consul-General in London, which was put into the post-office at Coblentz on the evening of the day succeeding our departure.*

"Thus prepared, and duly accoutred, at half-past one o'clock the balloon was dismissed from the ground, and rising gently under the influence of a moderate breeze, bore speedily away toward the south-east, traversing in her course the cultivated plains of Kent, and passing in succession nearly over the towns of Eltham, Bromley, Footscray and others, whose variegated outlines beautifully diversified the rich landscape that lay beneath us. The weather was uncommonly fine for the time of year; a few light clouds alone floated in the sky, and, at least as useful as ornamental, served to indicate the existence of different currents at different altitudes—an information of which, it will be seen hereafter, we were enabled to avail ourselves with much effect.

"Continuing in a south-easterly direction, at forty-eight minutes past two† we crossed the Medway, at the distance of about six miles to the

the whole night we had a lamp constantly burning, nor did we at any time suffer anxiety on account of its presence, or perceive any occasion, even temporarily, to wish for its extinction.

* Of the due arrival of this letter, and his Majesty's gracious reception of it, we received the following testimony in a letter from Mr. May shortly after we reached Paris:

LONDON, November 26, 1836.

SIR: Perceiving from the accounts in the newspapers that you and your friends have arrived at Paris, I lose no time in having the satisfaction of thanking you very sincerely for the care taken of the letter I took the liberty of entrusting to your kindness, for the purpose of having it forwarded to the king, at The Hague; it reached its destination on the 12th of November, through the post-office at Coblentz, and his Majesty was very much gratified at receiving a letter from England by so novel a mode of conveyance as a balloon. The king has written a memorandum on the letter "*to be carefully preserved*," wishing to keep it as a remembrance of this, as yet, extraordinary occurrence. I congratulate you and your companions on the success of your enterprise, and remain, with great regard, sir,

Your most obedient, humble servant,

J. W. MAY.

† The times and distances, as well as the direction of our course by the compass during the voyage being taken from the notes kept by Mr. Holland on the occasion, will account for the exact correspondence on these points between the different relations already before the public, which without this explanation might perhaps appear to border a little on the extraordinary.

west of Rochester, and in little more than an hour after* were in sight of the city of Canterbury, the lofty towers of its cathedral bearing distant about two miles in a westerly direction. In honor of the mayor and inhabitants of that city, under whose patronage our celebrated pilot had twice before ascended, we lowered a small parachute containing a letter addressed to the mayor, and couched in such terms as our hurried passage would permit us to indite.†

"In a few minutes after,‡ we obtained our first view of the sea, brightening under the last rays of a setting sun, and occupying the extreme verge of the horizon in the direction in which we were now rapidly advancing.

"During the latter period of this part of our voyage the balloon, perhaps owing to the condensation occasioned by the approaching shades of evening, had been gradually diminishing her altitude, and for some time past had continued so near the earth as to enable us without much exertion to carry on a conversation with such of the inhabitants as happened to be in our immediate vicinity. So close, indeed, were we at one time as to be able distinctly to observe a covey of partridges, which either our approach or some other equally dreaded apparition had dislodged from their resting-place and sent to seek a refuge on the borders of a wood which lay adjacent. A whole colony of rooks, alarmed, no doubt, by our formidable appearance, rose likewise in dismay, and after rending the air for miles round with their cries, and vainly trying the protection of the neighboring woods, finally dispersed, scattering themselves in every direction over the surface of the earth beneath.

"It was at this period of our voyage that the first opportunity occurred of showing how far it was possible for the skilful and experienced aëronaut to influence the course of his aërial vessel by availing himself of the advantages which circumstances frequently place at his disposal. Shortly after we had lost sight of the city of Canterbury a considerable deviation appeared to have taken place in the direction of our route. Instead of pursuing our former line of south by east, which was that of the upper current by means of which we had hitherto advanced, it became apparent that we were now rapidly bearing away upon one which tended considerably to the northward, and which, had we continued to remain within the limits of its influence, would have shortly brought us to sea in the direction of the North Foreland. As it had all along been an object to proceed as

* Five minutes past four.

† Of the due receipt of this letter, as well as of one to the same effect which we subsequently addressed to the mayor of Dover, we have since been informed, though the others, which we discharged by similar means at different periods of our voyage, we have reason to believe never reached the hands for which they were designed.

‡ Fifteen minutes past four.

near to Paris as circumstances would permit,* we resolved to recover as soon as possible the advantages which a superior current had hitherto afforded us, and accordingly rose to resume a station upon our previous level. Nothing could exceed the beauty of this manœuvre or the success with which the balloon acknowledged the influence of her former associate. Scarcely had the superfluous burden been discharged proportioned to the effect required, when slowly she arose, and sweeping majestically round the horizon, obedient to the double impulse of her increasing elevation and the gradual change of current, brought us successively in sight of all those objects which we had shortly before left retiring behind us, and in a few minutes placed us almost vertically over the castle of Dover, in the exact direction of crossing the straits between that town and Calais where it is confined within its narrowest limits.†

"It was forty-eight minutes past four when the first line of waves breaking on the beach appeared beneath us, and we might be said to have fairly quitted the shores of our native soil and entered upon the hitherto dreaded regions of the sea.

"It would be impossible not to have been struck with the grandeur of the prospect at this particular moment of our voyage, the more especially as the approaching shades of night rendered it a matter of certainty that it would be the last in which earth would form a prominent feature that we might expect to enjoy for a considerable lapse of time. Behind us the whole line of English coast, its white cliffs melting into obscurity, appeared sparkling with the scattered lights, which every moment augmented, among which the lighthouse at Dover formed a conspicuous feature, and for a long time served as a beacon whereby to calculate the direction of our course. On either side below us the interminable ocean spread its complicated tissue of waves without interruption or curtailment, except what arose from the impending darkness and the limited extent of our own perceptions; on the opposite side a dense barrier of clouds, rising from the ocean like a solid wall, fantastically surmounted, throughout its whole length, with a gigantic representation of parapets and turrets, batteries and bastions,

* The proprietors of the balloon having contemplated making an ascent from Paris, and Mr. Holland having undertaken to transfer the balloon thither, it became a consideration with us not to increase our distance from that capital more than was consistent with the main object of the expedition.

† It was undoubtedly at this period of our voyage, while the rapidity of our course appeared to be delayed by the circuitousness of our route, the length of time we consequently remained in sight, and, above all, the rectilinear direction of our approach, that originated the observation contained in the newspapers that the progress of the balloon did not exceed the rate of four or five miles an hour—an assertion which a slight consideration of the time we had left London and the distance we had accomplished would have been sufficient to disprove. According to the above method of calculation, the mean rate of our course up to the time referred to was somewhat more than twenty-five miles an hour.

and other features of mural fortifications, appeared as if designed to bar our farther progress, and completely obstructed all view of the shores toward which we were now rapidly drawing. In a few minutes after, we had entered within its dusky limits, and for a while became involved in the double obscurity of the surrounding vapors and of the gradual approach of night. Not a sound now reached our ears; the beating of the waves upon the British shores had already died away in silence, and from the ordinary effects of terrestrial agitation our present position had effectually excluded us.*

"In this situation we prepared to avail ourselves of those contrivances the merits of which, as I have already stated, it was one of the main objects of our expedition to ascertain; and consequently, to provide against the loss of power by the increase of weight proceeding from the humidity of the atmosphere naturally to be expected on the approach of night, we commenced lowering the copper vessels which we had provided for the occasion.

"Scarcely, however, had we completed our design, and were patiently awaiting the descent we had anticipated, when the faint sound of the waves beating against the shore again returned upon our ears and awakened our attention. The first impression which this event was calculated to convey was that the wind had changed, and that we were in the act of returning to the shores we had so shortly before abandoned. A glance or two, however, served to show us the fallacy of this impression; the well-known lights of Calais and the neighboring shores were already glittering beneath us; the barrier of clouds which I have before mentioned as starting up so abruptly in our path as abruptly terminated; and the whole adjacent coast of France, variegated with lights and alive with all the nocturnal signs of population, burst at once upon our view. We had, in fact, crossed the sea, and in the short space of about one hour from the time we had quitted the shores of England were floating tranquilly, though rapidly, above those of our Gallic neighbors.

"It was exactly fifty minutes past five when we had thoroughly completed this *trajet*, the point at which we first crossed the French shore bearing distant about two miles to the westward of the main

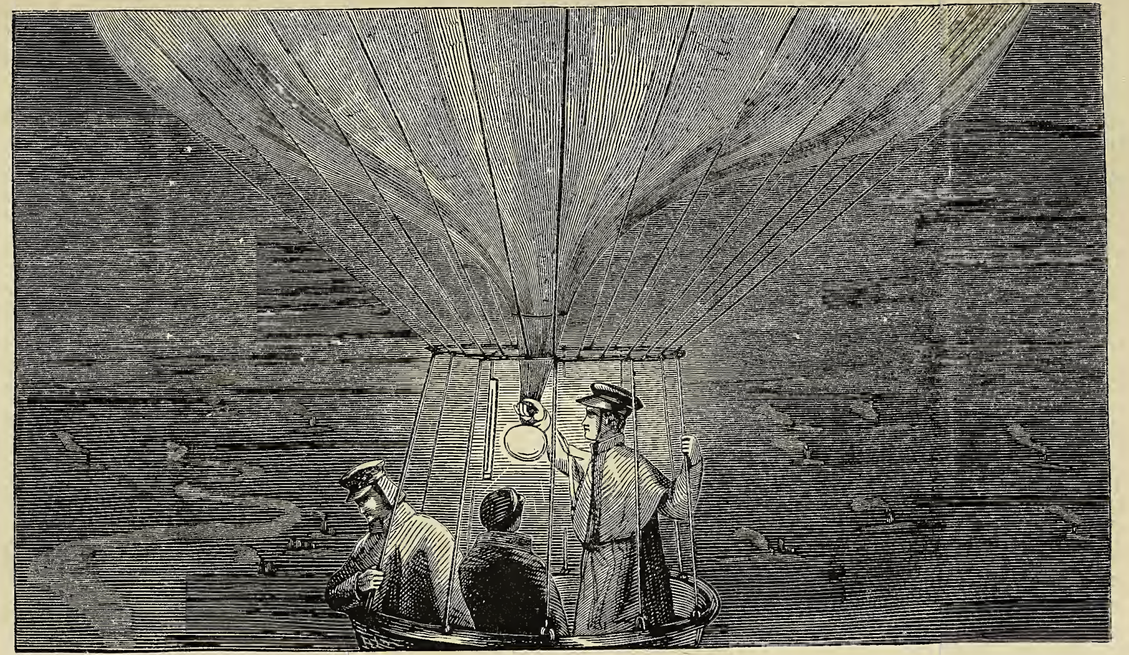
* I scarcely know whether it is an observation worthy of being committed to paper that the sea, unless perhaps under circumstances of the most extraordinary agitation, does not in itself appear to be the parent of the slightest sound; unopposed by any material obstacle, an awful stillness seems to reign over its motions. Nor do I think that even under any circumstances, no matter how violent, can any considerable disturbance arise from the conflict of its own opposing members. The impossibility of ever having been placed in a situation to bring this fact under the cognizance of our senses is no doubt the reason why it has never before been noticed. On the shore or in the sea no one has ever been present independent of that material support the absence of which is necessary to the success of the experiment; it is in the balloon alone, suspended in elastic ether, that such a phenomenon could either have been verified or observed.

body of the lights of Calais, our altitude at the time being somewhere about three thousand feet above the level of the ocean. As it was now perfectly dark, we lowered a Bengal light at the end of a long cord, in order to signify our presence to the inhabitants below; shortly after, we had the satisfaction to hear the beating of drums, but whether on our account or merely in performance of the usual routine of military duty we were not at the time exactly able to determine.

"Before dismissing the sea, a word or two seems required to counteract a vague and incorrect impression regarding its peculiar influence upon the buoyancy of the balloon, arising from the difficulties experienced by Messrs Blanchard and Jeffries in their passage of the same straits in the year 1785, and the apparently unaccountable remotion of their difficulties as soon as they had reached the opposite coast. So many, however, are the circumstances within the range of aëronautical experience to which, without intruding upon the marvellous or calling new affinities into existence, these effects can be satisfactorily attributed, that the actual difficulty lies in ascertaining to which of them they are most likely to have owed their origin; of these the increase of weight by the deposition of humidity on the surface of the balloon, occasioned by the colder atmosphere through which the first part of their journey had to be pursued, and the subsequent evaporation of the same by the rise of temperature to which they necessarily became subjected as soon as they came within the caloric influence of the land, is in itself quite sufficient to explain the difference that existed in the buoyancy of the balloon during the different stages of its progress. Even in the absence of any humidity whereby the actual weight of the balloon could have been increased, the mere diminution of temperature, by condensing its gaseous contents, and their subsequent rarefaction by the altered temperature they were sure to encounter when they reached the opposite coast, are more than enough to account for much greater effects than even those to which it is here intended to apply. As far as we were concerned, certainly no such uncommon impression was observable, nor did we experience any diminution of ascensive power in our transit across the sea, beyond what we should have expected under similar circumstances over a similar extent of land.

"The night having now completely closed in, and no prospect of any assistance from the moon to facilitate our researches, it was only by means of the lights which, either singly or in masses, appeared spreading in every direction that we could hope to take any account of the country we were traversing, or form any opinion of the towns or villages which were continually becoming subjected to our view.

"The scene itself was one which exceeds description. The whole plane of the earth's surface for many and many a league around, as far and farther than the eye distinctly could embrace, seemed absolutely teeming with the scattered fires of a watchful population, and exhibited a starry spectacle below that almost rivalled in brilliancy the remoter lustre of the concave firmament above. Incessantly during



HOLLAND, GREEN AND MASON OVER LIEGE AT NIGHT.

the earlier portion of the night, ere the vigilant inhabitants had finally retired to rest, large sources of light betokening the presence of some more extensive community would appear just looming above the distant horizon in the direction in which we were advancing, bearing at first no faint resemblance to the effect produced by some vast conflagration, when seen from such a distance as to preclude the minute investigation of its details. By degrees, as we drew nigh, this confused mass of illumination would appear to increase in intensity, extending itself over a larger portion of the earth, and assuming a more distinct form and a more imposing appearance, until at length, having attained a position from whence we could more immediately direct our view, it would gradually resolve itself into its parts, and shooting out into streets or spreading into squares, present us with the most perfect model of a town, diminished only in size according to the elevation from which we happened at the time to observe it.

"It would be very difficult, if not impossible, to convey to the minds of the uninitiated any adequate idea of the stupendous effect which such an exhibition, under all its concomitant peculiarities, was calculated to create. That we were by such a mode of conveyance amid the vast solitude of the skies in the dead of night, unknown and unnoticed, secretly and silently reviewing kingdoms, exploring territories and surveying cities in such rapid succession as scarcely to afford time for criticism or conjecture, was in itself a consideration sufficient to give sublimity to far less interesting scenes than those which formed the subject of our present contemplations. If to this be added the uncertainty that from henceforward began to pervade the whole of our course—an uncertainty that every moment increased as we proceeded deeper into the shades of night and became farther removed from those landmarks to which we might have referred in aid of our conjectures, clothing everything with the dark mantle of mystery and leaving us in doubt more perplexing even than ignorance as to where we were, whither we were proceeding and what were the objects that so much attracted our attention—some faint idea may be formed of the peculiarity of our situation and of the impressions to which it naturally gave rise.

"In this manner and under the influence of these sentiments did we traverse with rapid strides a large and interesting portion of the European continent, embracing within our horizon an immense succession of towns and villages, whereof those which occurred during the earlier part of the night the presence of their artificial illumination alone enabled us to distinguish.

"Among these latter, one in particular, owing to its own superior attractions, the length of time it continued within our view and the uninterrupted prospect which our position directly above it enabled us to command, captivated our attention and elicited constant expressions of mingled admiration and surprise. Situated in the centre of a district which actually appeared to blaze with the innumerable fires

wherewith it was studded in every direction to the full extent of all our visible horizon, it seemed to offer in itself and at one glance an epitome of all those charms which we had been previously observing in detail. The perfect correctness with which every line of street was marked out by its particular line of fires, the forms and positions of the more important features of the city, the theatres and squares, the markets and public buildings, indicated by the presence of the larger and more irregular accumulation of lights, added to the faint murmur of a busy population still actively engaged in the pursuits of pleasure or the avocations of gain,—all together combined to form a picture which for singularity and effect certainly could never before have been conceived. This was the city of Liege, remarkable from the extensive iron-works which, abounding in its neighborhood, occasioned the peculiar appearance already described, and at the time led to that conjecture concerning its identity the truth of which a subsequent inquiry enabled us to confirm.

"This was the last spectacle of the kind which we were destined to enjoy. Scarcely had we completely cleared the town and the fiery region in which it was embosomed ere an unbroken obscurity, more profound than any we had yet experienced, involved us in its folds and effectually excluded every terrestrial object from our view.

"It was now past midnight, and the world and its inhabitants had finally committed themselves to repose. Every light was extinguished and every sound hushed into silence; even the cheerful tones of the vigilant watch-dog, which had frequently contributed to enliven our course during the previous portion of the night, had now ceased, and darkness and tranquillity reigned paramount over the whole adjacent surface of the globe.

"From this period of our voyage until the dawning of the following day the record of our adventures becomes tinged with the obscurity of night. The face of nature completely excluded from our view, except when circumstances occasionally brought us into nearer contact with the earth, all our observations during the above period are necessarily confined to a register of incidents and sensations mingled with vague conjectures, and clouded with the mystery wherewith darkness and uncertainty were destined to involve so large a portion of the remainder of our expedition. The moon, to which we might have looked up for companionship and assistance had she been present, was nowhere to be seen. The sky, at all times darker when viewed from an elevation than it appears to those inhabiting the lower regions of the earth, seemed almost black with the intensity of night; while, by contrast, no doubt, and the remotion of intervening vapors, the stars, redoubled in their lustre, shone like sparks of the whitest silver scattered upon the jetty dome around us. Occasionally faint flashes of lightning, proceeding chiefly from the northern hemisphere, would for an instant illuminate the horizon, and, after disclosing a transient prospect of the adjacent country, suddenly subside, leaving us involved in more than our original

obscurity. Nothing, in fact, could exceed the density of night which prevailed during this particular period of the voyage. Not a single object of terrestrial nature could anywhere be distinguished; an unfathomable abyss of 'darkness visible' seemed to encompass us on every side; and as we looked forward into its black obscurity in the direction in which we were proceeding, we could scarcely avoid the impression that we were cleaving our way through an interminable mass of black marble in which we were imbedded, and which, solid a few inches before us, seemed to soften as we approached, in order to admit us still farther within the precincts of its cold and dusky enclosure. Even the lights which at times we lowered from the car, instead of dispelling, only tended to augment, the intensity of the surrounding darkness, and as they descended deeper into its frozen bosom, appeared absolutely to melt their way onward by means of the heat which they generated in their course.

"The cold, during this part of the night especially, was certainly intense, as could be perceived not less from the indications of the thermometer (ranging variously from within a few degrees below to the point of congelation) than from the effects which it produced upon the different liquors wherewith we were provided. The water, coffee and, of course, the oil in our several vessels, were completely frozen, and it was only by the actual application of the heat of the lamp that we were enabled to procure a sufficiency of the latter to supply our wants during the long term of darkness to which we were about to be subjected.

"Strange, however, as it may appear, while all around bore such unequivocal testimony to the severity of the cold, the effects produced upon our persons, undefended as they were by any extraordinary precautions, were by no means commensurate to the cause, nor such as, even under ordinary circumstances, we might fairly have expected to encounter. The reason to which may be attributed this unusual exemption from the consequences of a low temperature is the absence of all current of air, the natural result of our situation and one of the peculiar characteristics of aërial navigation.*

"To this intensity of cold, preceded by a long subjection to the action of a humid atmosphere while floating at a lower elevation, is likewise to be attributed the occurrence of an incident which, for the impression it is calculated to produce upon the minds of those who experience it for the first time, and in ignorance of its cause, merits particularly to be noticed.

"It was about half-past three in the morning when the balloon, having gained a sudden accession of power, owing to a discharge of ballast which had taken place a few minutes before while navigating too near

* After what has been stated respecting the temperature to which we were subjected, it will be unnecessary to offer any further disproval of the absurd reports which were circulated concerning its severity and the serious consequences which we were supposed to have suffered from our exposure to it during the night.

the earth to be considered perfectly safe in a country with the main features of which we were totally unacquainted, began to rise with considerable rapidity, and, ere we had taken the customary means to check her ascent, had already attained an elevation of upward, of twelve thousand feet. At this moment, while all around is impenetrable darkness and stillness most profound, an unusual explosion issues from the machine above, followed instantaneously by a violent rustling of the silk and all the signs which may be supposed to accompany the bursting of the balloon in a region where nothing but itself exists to give occasion to such awful and unnatural disturbance. In the same instant the car, as if suddenly detached from its hold, becomes subjected to a violent concussion, and appears at once to be in the act of sinking, with all its contents, into the abyss below. A second and a third explosion follow in quick succession, accompanied by a recurrence of the same astounding effects, leaving not a doubt upon the mind of the unconscious voyager of the fate which nothing now appears capable of averting. In a moment after, all is tranquil and secure; the balloon has recovered her usual form and stillness, and nothing appears to designate the unnatural agitation to which she has been so lately and unaccountably subjected. The occurrence of this phenomenon, however strange it may appear, is nevertheless susceptible of the simplest resolution, and consists in the tendency to enlargement, from remotion of pressure, which the balloon experiences in rising from a low to a higher position in the atmosphere, and the resistance to this enlargement occasioned by the network, previously saturated with moisture and subsequently congealed into the elliptical form which the dependent weight of the car obliges it to assume, whenever the shrunken capacity of the sphere it encompasses will admit of its longitudinal distension. As this resistance is occasioned by the intervention of a *non-elastic* medium (the ice) which has bound the meshes of the network in their contracted form, it is evident that the liberation occasioned by their disrupture will not take place until the internal pressure of the balloon has reached a certain amount, when suddenly that liberation is accomplished, attended by those collateral effects which we have already attempted to describe. The impression of the descent of the car in the above representation is evidently a false one; the car, so far from sinking, actually springs up; it is the unexpectedness of such a movement and its apparent inconsistency with the laws of gravitation that occasion the delusion, the reality of which the concomitant circumstances essentially tend to confirm.

"Several times during the latter part of the night we had approached so near to the earth as to be enabled to observe, imperfectly, it is true, some of its most prominent features, and to obtain some faint idea of the nature of the ground beneath us. At these times we appeared to be traversing large tracts of country partially covered with snow, diversified with forests and intersected occasionally with rivers, of which the Meuse in the earlier part of the night, and the Rhine

toward the conclusion, formed, as we afterward learned, the principal objects both of our admiration and of our conjectures.

"Large masses of fleecy clouds would at times likewise occupy the lower regions of the atmosphere, intercepting our view as we descended, and for a while leaving us in doubt whether they were not a continuation of those snowy districts which we so frequently had occasion to remark.

"From out of this mass of vapors more than once during the night our ears became assailed with sounds bearing so strong a resemblance to the rushing of waters in enormous volumes, or the beating of the waves upon some extensive line of coast, that it required all our powers of reasoning, aided by the certain knowledge we had of the direction we were pursuing, to remove the conviction that we were approaching the precincts of the sea, and, transported by the winds, were either thrown back upon the shores of the German Ocean or about to enter upon the remoter limits of the Baltic.

"It would be endless to enumerate all the conjectures to which this phenomenon gave rise, or the various manners by which we endeavored to explain its occurrence. Among them those which seemed to obtain the greatest credit were that the sound proceeded from some vast forest agitated by the winds, some rapid river rushing impetuously over a broken and precipitous channel, or finally that the misty vapors themselves, by the mutual action of their watery particles, or their precipitated deposition upon the irregular surface of the earth beneath, had occasioned the murmurs which, multiplied throughout so large a space, came to our ears in the formidable accents to which we have above alluded. According as the day drew nigh these appearances vanished, with much of the doubts to which they had given rise. Instead of the unbroken outline of the sea, an irregular surface of cultivated country began gradually to display itself, in the midst of which the majestic river we had noticed for some time back appeared, dividing the prospect and losing itself in opposite directions amid the vapors that still clung to the summits of the hills or settled in the valleys that lay between them. Across this river we now directed our course, and shortly after lost sight of it entirely behind the gently-swelling eminences by which it was bordered on both sides.

"It was about six o'clock,* during an ascent which occurred shortly after we had crossed this river, that the balloon, having reached a considerable elevation, showed us our first view of the sun and gladdened us with the prospect of a speedy approach of day. Powerful indeed

* The time referred to here and elsewhere throughout this narrative is that of Greenwich. Upon the completion of the voyage a difference amounting to about thirty-four minutes was found to exist between the times indicated at its two extremes, the chronometers of Weilburg being so much in advance of those of London. This difference was occasioned by the easterly direction of our course, and the difference in latitude to the extent of eight degrees twenty minutes between the two places.

must be the pen which could hope to do justice to the scene like that which here presented itself to our view. The enormous extent of the prospect,* the boundless variety it embraced, the unequalled grandeur of the objects it displayed, the singular novelty of the manner under which they were beheld, and the striking contrast they afforded to that situation and those scenes to which we had so long and so lately been confined, are effects and circumstances which no description is capable of representing in the light in which they ought to be placed in order to be duly appreciated. Better by far to leave it to a fertile imagination to fill in the faint outlines of a rough and unfinished sketch than by a lame and imperfect coloring run the risk of marring a prospect which for grandeur and magnificence has certainly no parallel in all the vast and inexhaustible treasures of nature.

"This splendid spectacle, however, we were not long destined to enjoy; a rapid descent, which shortly after ensued, for a while concealed it from our view, and once more consigned us to the shades of night, which still continued to reign unbroken throughout the lower region of the air.

"Again we rose within the reach of this delightful prospect, and again did we lose sight of it amid the vapors and obscurity that accompanied our descent; nor was it till we had three times made the sun rise and twice beheld it set that we could fairly consider it established above the horizon, and daylight complete upon the plane of the earth beneath us.

"From this time forward all our observation was principally directed to the nature of the country and its adaptation to the descent which we had now resolved to effect on the first fitting opportunity. To this step the uncertainty in which we necessarily were with respect to the exact position we occupied, owing to our ignorance of the *distance* we had come, especially determined us. For a long time past the appearance of the country, so unlike any with which we were acquainted, had led us to entertain serious doubts as to whether we had not already passed the limits of that part of Europe where we might expect to find the accommodation and conveniences which our own comfort and the safety of the balloon imperatively demanded. This opinion the large tracts of snow over which we had passed during the latter part of the night, bearing a strong resemblance to all we had hitherto pictured to ourselves of the boundless plains of Poland or the barren and inhospit-

* If we only reflect that our position when at this altitude could enable us to behold objects at a distance of above one hundred and fifty miles on every side of us, had these objects been sufficiently great or sufficiently striking to fix the attention, some idea may be had of the vast extent of our prospect at this particular moment of our voyage. We shall then be seen occupying the centre of a circle whose diameter, extending to above three hundred miles in length, afforded us a horizon the circumference of which, extending an equal number of leagues, comprised within its circuit an extent of visible surface little short of eighty thousand square miles.

able steppes of Russia, considerably tended to confirm; and as the region we were immediately approaching seemed to offer advantages which under these circumstances we could not always hope to command, we resolved not to lose the occasion it so opportunely appeared to have afforded us. As soon as we had come to this determination, all preparations were speedily commenced for the descent; the guide-rope was hauled in—an operation of much labor, owing to the bad construction and imperfect action of the windless—the grapnel and cable lowered and everything got ready, that we might be able to avail ourselves of the first and fittest opportunity that might occur. To this intent likewise we quitted our exalted station and sought a more humble and appropriate level, along which we continued to range for some time and to a considerable distance, the yet early hour of the day deterring us from completing the descent, in the fear of not obtaining that ready assistance from the inhabitants which it is always the main object of the aëronaut if possible to secure. As the mists of the night began to clear away from the surface of the soil, we were delighted to perceive a country intersected with roads, dotted with villages and enlivened with all the signs of an abundant and industrious population. One or two towns of superior pretensions were distinctly to be seen, giving promise of accommodation and advantages which in our present emergencies and under our present convictions were not to be neglected. Accordingly, having pitched upon the spot best suited for the purpose, the valve was opened, and we commenced our descent. The place selected was a small grassy vale of about a quarter of a mile in breadth, embosomed in hills whose side and summits were completely enveloped with trees. Beyond this, on the opposite side, lay another valley of the same description, the only one visible for many miles where we could conveniently effect our landing, an endless succession of forest scenery completing the landscape in the direction in which we should have to proceed. Into the former of these we now precipitated our descent, with the design of alighting if possible in the centre, clear of the woods that enclosed it on all sides. In these hopes we were, however, disappointed; the wind, suddenly increasing as we approached the ground, so much accelerated the rapid progress of the balloon that before the grapnel could take effectual hold of the soil we had passed the middle of the valley, and sweeping rapidly over the ground, were borne close against the wooded declivity that flanked its eastern termination. To discharge a sufficiency of ballast to raise the balloon and carry her clear of the impending danger was the natural remedy. An unexpected obstacle to this operation here again presented itself: the sand which forms the ballast, frozen during the night into a solid block of stone, refused to quit the bag in the proportion required, and no time remained to search for one more suited to the occasion. Not a moment was, in fact, to be lost; the valley was passed, and the branches of the trees that clotted the opposing precipice were already within a few feet of the balloon; the grapnel continued to drag, and no chance appeared of arresting her progress

onward. In this emergency one alternative alone remained, and the sack itself, with all its contents, to the amount of fifty-six pounds in weight, was at once consigned to the earth. In a moment the balloon, lightened of so large a portion of her burden, had sprung up above one thousand feet, and clearing the mountain at a bound, was soon in rapid progress to the realms above. To counteract the consequence of this sudden accession of power, and avoid being carried beyond the reach of the second valley, which we have already described as the only other available spot for our descent, the valve was again opened and issue given to a large quantity of gas, sufficient, as was calculated, to check the course of the balloon in time to enable us to attain the point to which all our views were now directed. A second time, however, were we doomed to be disappointed. No sooner had we completed this manœuvre than, by another caprice of nature the wind suddenly abating, we found ourselves at once becalmed and rapidly descending into the bosom of the woods that capped the summit and clothed the sides of the intervening eminences. From this dilemma we were only relieved by the timely discharge of a further portion of our weight, not, however, before the accelerated descent of the balloon had brought us within a cable's length of the ground,* and almost in contact with the upper surface of the wood. Here for a few moments we continued to hover, the grapnel struggling with the topmost branches of the trees, and grasping and relinquishing its hold according to the varying impulse of the slight wind that prevailed at our elevation. While in this situation, we perceived standing in the path of the wood two females, the first inhabitants we had noticed, lost in astonishment and absolutely petrified with gazing upon so astounding an apparition. It was in vain we addressed them with a speaking-trumpet, in the hopes of procuring the assistance of some of the male population, which we conjectured could not be far off; the sound of our voices, proceeding from such an altitude and invested with such an unearthly character, only augmented their astonishment and added to their fears; they fled precipitately, and without waiting further parley sought the shelter of the neighboring coverts.

"After continuing for a few minutes longer in these straits, we at length reached the confines of the wood, when, resolving not to be again baffled in our designs by the treacherous inconstancy of the wind, the valve was opened to its fullest dimensions; and the grapnel taking hold shortly after, we came to the ground with considerable though by no means disagreeable rapidity.†

* The length of the cable to which the grapnel is attached is about one hundred and twenty feet.

† Too much praise cannot be given to Mr. Green for his excellent conduct throughout the whole of this intricate pilotage. It is not by reading a mere description of the difficulties encountered and the manner by which they were counteracted that a correct judgment can be formed upon the proper merits of such a case as this; further consideration is necessary—the knowledge that these difficul-

"As soon as the descent was completed and the power of the balloon sufficiently crippled to permit one of the party to quit the car,* the inhabitants, who had hitherto stood aloof regarding our manœuvres from behind the trees, began to flock in from all quarters, eyeing at first our movements with considerable suspicion, and not seldom looking up in the direction from which we had just alighted, in the expectation, no doubt, of witnessing a repetition of this to them inexplicable phenomenon.

"A few words in German, however, served to dissipate their fears and secure their services, when, as if eager by present assiduity to make amends for former backwardness, they absolutely seemed to contend with each other in their exertions to afford us assistance and execute our several behests. To this kindly feeling we endeavored to contribute by every means in our power. Our stock of biscuits, wine and brandy quickly disappeared with a relish which the novelty of the journey they had so lately performed tended, no doubt, considerably to augment. The brandy in particular, so much stronger than any they had ever before essayed, attracted their special admiration, and as they each in succession drank off their allowance, seemed, by the exclamation of 'Himmlischer Schnapps,'† which accompanied every draught, as well as by the upward direction of their eyes, to denote the quarter from which they now became fully convinced a beverage so delicious could alone have proceeded. From them we now also learned where it was that we really had alighted, and for the first time became aware that we were in the grand duchy of Nassau and about two leagues from the town of Weilburg, the nearest where we could expect to meet with the accommodation which the circumstances of the case rendered desirable.‡ Thither, therefore, we determined to proceed; and having procured a cart and horses for the transportation of the balloon, we quitted this to us ever memorable spot, and attended by an amazing concourse of persons of every rank, age and sex, set out for Weilburg, which a few hours enabled us to attain.

"The fame of our adventure had, however, already preceded us.

ties did not proceed from the same source as the remedies by which they were defeated. In this light it is that the conduct of our celebrated captain has a right to be criticised: the impediments were those of uncontrollable nature—the victory and the means employed to secure it were all his own.

* It was half-past seven o'clock when this occurrence took place and our descent could be fairly said to be completed. The duration of our voyage may therefore be calculated at exactly eighteen hours.

† The literal interpretation of the above expression is "Celestial dram."

‡ The exact spot where the event took place was in a field adjacent to a mill known by the name of Dillhausen, situated in the valley of Elbern, in the commune of Niederhausen, about two leagues from the town of Weilburg, already by a curious coincidence noted in the annals of aërostation as the place where the celebrated M. Blanchard effected his landing after an ascent which he made at Frankfort in the year 1785.

On our approach we found ourselves greeted with acclamations, and a ready welcome and honorable attentions awaited our arrival; all the resources of the town were immediately placed at our disposal; the use of the archducal manège was tendered for the occupation of the balloon, and sentries, more indeed as a guard of honor than protection, stationed at the doors and avenues leading to the place of its reception.

"Here, then, we resolved to remain until our future movements should be determined by the return of the letters we had despatched to Paris immediately upon our descent. In the mean time we took advantage of this delay to open and inflate the balloon, as well for the purpose of drying and examining it as to make some return for the obligations we were under by contributing to gratify the curiosity of our hospitable entertainers. It would be scarcely credible were I to relate the interest wherewith the inhabitants seemed to regard this to them novel exhibition, the numbers that poured in to witness it from all quarters for many a league around, or the grateful acknowledgments with which they never ceased to overwhelm us during the fortnight it continued open to public inspection.

"Nothing, in fact, could surpass the courtesy and attention that we experienced from this simple-hearted and hospitable community during the whole period of our residence at Weilburg. Every one seemed to vie with each other in conferring favor and contributing to our entertainment; balls, dinners, concerts and other amusements in honor of our adventure were given without intermission, and the congratulations of the city were presented to us by a deputation of the principal citizens, headed by their chief civil officer, in the form of a document duly signed and sealed by the competent authorities. Among the festive recreations to which our unexpected arrival at Weilburg gave rise, we must not omit to mention the ceremony of christening the balloon, which took place the day previous to our departure, the baron de Bibra, Grand Maître des Eaux et Fortês, and the colonel baron de Preen, being the godfathers, the baroness de Bibra and the baroness de Dungern the godmothers, on the occasion. The balloon having been inflated to the greatest size the dimensions of the place would admit, eight young ladies, in company with Mr. Green, entered within the gigantic sphere, and the name of 'The Great Balloon of Nassau' having been bestowed by one of their number, Mlle. Theresa, the lovely and amiable daughter of the baron de Bibra, accompanied by a copious libation of wine, the ceremony was concluded with a collation consisting of the remains of our stock of provisions which had been unconsumed at the time of our descent.

"From such a universal display of hospitality and kindness it would be difficult to single out any to whom in particular our thanks are due; among those, however, whose station and circumstances entitle them to especial notice, were the baron de Bibra, Grand Maître des Eaux et Forêts; the baron de Dungern, Grand Ecuyer de son Altesse,

pensionne; the colonel baron de Preen, and their respective ladies; M. Hutschsteiner, Premier Conseiller de Médecine; M. Giesse, Premier Conseiller de Justice; M. Freydemann, Superior of the University, and M. Barbieux, likewise attached to the same establishment, together with a variety of others the mere repetition of whose names would prove but a little recompense for the kindness we received at their hands. Through the baron de Bibra, likewise, we took the opportunity to present to his Highness the archduke of Nassau the flags* which accompanied the expedition, as a slight token of the hospitable reception we had experienced in his territories, with a request that they should be preserved in commemoration of the occurrence among the archives of the ducal palace at Weilburg, where they now lie alongside of that which half a century before M. Blanchard deposited in like manner to perpetuate the remembrance of a like event.

"Thus ended an expedition which, whether we regard the extent of country it passed over, the time wherein it was performed or the result of the experiment for the sake of which it was undertaken, may fairly claim to be considered among the most interesting and important which have hitherto proceeded from the same source. Starting from London and traversing the sea, which mere accident alone prevented from forming a more important feature in our route, in the short space of eighteen hours, we performed a voyage which, including only those deviations we have since been enabled to ascertain, rather exceeds than falls short of an extent of five hundred British miles.

"It would be endless as well as useless to enumerate all the places of name or notoriety which a subsequent examination of the map, aided by the reports of our appearance at different stations by the way, showed us to have either passed over or approached at some period or other during this extraordinary peregrination. A considerable portion of five kingdoms—England, France, Belgium, Prussian Germany and the archduchy of Nassau—a long succession of cities, including London, Rochester, Canterbury, Dover, Calais, Cassel, Ypres, Courtray, Lille, Audenaerde, Ath, Brussels, with the renowned fields of Waterloo and Genappe, Namur, Liege, Spa, Malmedy, Coblentz, and a whole host of intermediary villages of minor note, were all brought within the compass of our horizon, which our superior elevation† and various

* Besides the usual national insignia, these flags presented a series of allegorical representations descriptive of the rise and progress of aërostation. Independent, however, of any merit which they might possess from their execution or design, there was one circumstance in their history which rendered them invaluable in the eyes of the aëronaut: they had already performed two hundred and twenty-one voyages in the air, having been the constant companions of Mr. Green's excursions ever since his fifth ascent, wherein he had the misfortune to lose his balloon and all it contained in the sea off Beechy Head.

† The propriety of economizing our resources during the commencement of a voyage the duration of which was a matter of uncertainty, occasioned our mean

aberrations enabled us to extend far beyond what might be expected from a mere consideration of the line connecting the two extremities of our route.

"To all this there was but one drawback—in the time of year in which the experiment was conducted, which, by curtailing our daylight, devoted to the obscurity of night so large and interesting a portion of the expedition. Over this, however, we had no control; the constant occupation of the balloon for the purposes of public exhibition during the summer months left no chance of its being procurable at a better season of the year, especially for a project such as ours, the determination of which as to time and distance was a matter of complete uncertainty. The excursion must therefore have been undertaken as it was or altogether abandoned; of these alternatives Mr. Holland unhesitatingly preferred the former.

"Ere concluding this hasty narrative, a word or two is required concerning the success of that experiment which formed the main feature as well as the chief object of the expedition. This success I feel no hesitation in now declaring to be complete, and the discovery itself one the entire result of which on the future progress of the art it would be impossible at present to anticipate. With such an instrument as this there now seems to be no limit to the powers of aërostation—no bounds to its sphere of action. All the theoretical objections which a hasty consideration of the means might otherwise have suggested ex-

altitude to be rather under than over the extreme of aëronautical adventure. In the morning, however, as these necessities became less urgent, and we could afford to devote something to mere amusement, we frequently rose to an elevation of about twelve thousand feet, occasionally higher. At no time, however, did we experience the *slightest* effect upon our bodies proceeding from the diminished pressure of the atmosphere. Nor, from what my own observations, and still more those of Mr. Green (whose experience in such matters far outweighs that of all the aëronautical world together), would lead me to assert, do I believe that any such effects as are currently attributed to this diminished pressure have any existence at all—at least, at any elevation to which any person has hitherto been enabled to arrive. The impressions experienced in the ascent of high mountains, which have no doubt led to the adoption of such opinions, and induced aëronauts with more regard to fame than veracity to anticipate and assert effects they thought they would have experienced had they reached the elevation they fain would have the credit for, owe their existence to another cause, and proceed from the inordinate muscular exertion and its consequences upon the circulating system developed in the attempt.

I am aware that great names appear in array against such an opinion, and likewise that nothing but the having arrived at the same altitude without experiencing the same results can authorize the flat denial of another's experience. If, however, at an altitude of three miles and three-quarters, *no* symptom whatever is to be felt of those effects which at a *quarter of a mile* farther evince themselves by such terrific consequences, the world is at least at liberty to exercise its own judgment upon the case.

periment has now proved to be erroneous; and perhaps the best answer that can be given to those who might be inclined to question the practicability of its employment or cavil at its effects is that by such means alone have we been enabled, without let or hindrance, danger or difficulty, to traverse so large a portion of the European continent, descending at a distance of about five hundred miles from the place of our departure, with power enough to have enabled us, had we been so intentioned, to have continued our course throughout the whole circumference of the globe."

## CHAPTER XIX.

Fatal parachute descent of Mr. Cocking from the Nassau balloon, at London—Account from the London "Penny Mechanic" of July 29, 1837.

THE following account of Mr. Cocking's fatal parachute descent is taken from the London "Penny Mechanic" of July 29, 1837:

"We regret to have to state that the experiment of the descent of the parachute has terminated fatally to Mr. Cocking. In consequence of the announcement that he was to ascend in his parachute suspended to the great Nassau balloon, a great number of persons, among whom were many of the first nobility of the country, assembled in the gardens to witness the experiment. Outside the gardens, upon Vauxhall bridge and upon Millbank, the crowd was immense. The circumference of the balloon was 107 feet 4 inches. From the bottom of this machine, which was constructed of fine Irish linen, a basket of wicker was suspended, in which Mr. Cocking placed himself. The distance between the basket and the car, in which were Mr. Green and Mr. Spencer, was between forty and fifty feet. The ascent of the balloon took place about twenty minutes before eight o'clock. When Mr. Cocking entered the basket of the parachute, he was perfectly collected, and exhibited no appearance of want of nerve or indecision.

"At twenty minutes to eight o'clock, everything being in readiness and the parachute attached to the car of the balloon, the ascent took place. Nothing could be more majestic. The weight and great extent of the parachute apparently rendered the motion of the balloon more steady than on any former ascent, and the almost total absence of wind assisted in keeping the balloon in a perfectly perpendicular position. There was not the slightest oscillation; the balloon and parachute sailed through the air with a grandeur which exceeded anything of the kind ever before witnessed, and continued in sight for about ten minutes. A good deal of ballast was discharged almost immediately over the enclosure, after which the huge machine rose rapidly, but not so suddenly as to break the even current of its course. It was expected by those in the gardens that Mr. Cocking would have descended so near Vauxhall as to afford them a view of his descent. This was not the case. He was lost in the clouds, and the company were for some

time left in conjecture, but certainly not in anticipation of the result of the experiment. A son of Mr. Gye was the first person who announced to our informant the fatal catastrophe. This gentleman followed on horseback, and arrived in a field near Lee, in Kent, just in time to learn that the parachute had descended with such violence that Mr. Cocking had lost his life in his experiment. The intelligence was not suffered to transpire for some time, in hopes that the account might be incorrect, and that Mr. Cocking might have only been stunned or have fainted, it being remembered that something of this sort occurred on the descent of M. Garnerin some years ago. It was, however, very shortly ascertained that the intelligence was too true. It appears that the descent of the parachute was made over a field close to Lee, that on approaching the ground the parachute, from some cause or other, most probably from the fact that the hoop which distended the external circumference, being composed of a hollow tube of tin, collapsed, and consequently opposed no resistance whatever to the atmosphere, but turned over and over in the air and came down with a frightful velocity. Mr. Cocking was not, we understand, thrown out of the basket, but he received a dreadful wound on the right temple and had his ankle dislocated. He moved his hand once after his fall, but exhibited no other signs of life. Several country people, who were close by, procured a wattled hurdle, placed him upon it, and conveyed him without delay to the Tiger's Head Inn at Lee. He was immediately attended by Dr. Chowne, who was on the spot, but all medical assistance was unavailable. The arteries of his arms were opened, but it was to no purpose; life had fled. It is but justice to say that this fatal result is attributable in no manner to any person connected with Vauxhall or with the balloon. Mr. F. Gye endeavored, but in vain, to persuade Mr. Cocking to have the hoop of the parachute of ash, but that unfortunate gentleman, from a notion that tin would be sufficiently strong and much lighter, refused to listen to his suggestion.

"'The inflation,' says Mr. Green, 'commenced about twelve, under the able direction of the engineer to the London Gas Company, and was completed by five o'clock. Prior to the parachute being attached to the balloon, I caused a trial to be made, with the view of ascertaining whether the buoyancy of the latter was sufficient to carry up the former with safety. The result of this trial was, after some arrangements with respect to the ballast, of which I was compelled to give out about 650 lbs. in weight, in every respect, satisfactory. The abandonment of this large quantity of ballast I found to be absolutely requisite in order with safety to commence the ascent. The balloon was then allowed gently to rise a sufficient height to be conveyed over the parachute; but in consequence of the great and unavoidable delay which was necessarily caused in affixing the two machines, the gas in the former became very considerably condensed from a reduction of its temperature. It thereupon became a matter of compulsion that I should get rid of 100 lbs. more of the ballast, which I emptied out of

the bags through a tube constructed of canvas, and about fifty feet in length. The object in having this tube was that any ballast I might deem it advisable to throw out during our voyage should take such a course as would entirely clear the broadest expanse of the parachute. The connection between the balloon and the parachute was at length completed by the rope of the latter being made fast to the liberating iron by which Mr. Cocking was to free himself from the balloon.

"'It is but justice to myself, I should here state, that I had on several occasions expressed my determination not to liberate the parachute from the balloon upon the ground, setting aside any other considerations that I might select a moment for the severance when Mr. Cocking was not altogether prepared or ready for his descent, and therefore, if any accident were to accrue to him, that I of course should be regarded as the responsible party, and the one to whom blame would naturally attach.

"'Mr. F. Gye, everything being in readiness, about twenty-five minutes to eight o'clock, gave the signal for the whole of the apparatus to be released from its trammels, and we instantly rose very steadily, taking an easterly course.

"'Mr. Cocking had always desired that we should ascend to an elevation of 8000 feet—about one mile and a quarter—at which height he proposed to detach himself from the balloon, and to commence his descent. Finding, therefore, that our upward progress was very slow, I requested Mr. Spencer to discharge some more ballast, and he accordingly threw the contents of a bag weighing twenty pounds through the tube already named. This proving of little avail, I directed a second and then a third bagful to be got rid of by the same means.

"'As soon as we had attained the height of 5000 feet, I told him that it would be impossible to get up as high as he desired in a sufficient time for him to descend by the light of day. Upon this Mr. Cocking said, 'Then I shall very soon leave you; but tell me whereabouts I am?' Mr. Spencer, who had a few minutes before caught a glimpse of the earth, answered, 'We appear to be on a level with Greenwich.' I then asked him if he felt himself quite comfortable, and whether he found that the practical trial bore out the calculations he had made. Mr. Cocking replied, 'Yes; I never felt more comfortable or more delighted in my life.' Shortly afterward Mr. Cocking said, 'Well, now I think I shall leave you.' I answered, 'I wish you a very good-night and a safe descent, if you are determined to make it, and not to use the tackle' (an apparatus, constructed under the direction of Mr. F. Gye, to afford us the facility of assisting Mr. Cocking to haul himself up into the car of the balloon if necessary). Mr. Cocking to this question made no other reply than 'Good-night, Spencer; good-night, Green.' At this instant I desired Mr. Spencer to take fast hold of the ropes, and, like myself, to crouch down in the car. Scarcely were these words uttered before we felt a slight jerk upon the liberating iron, but quickly discovered, from not having changed our elevation, that Mr.

Cocking had failed in his attempt to free himself. Another but more powerful jerk ensued, and in an instant the balloon shot upward with the velocity of a skyrocket.

"'The effect upon us at this moment is almost beyond description. The immense machine which suspended us 'between heaven and earth,' whilst it appeared to be forced upward with terrific violence and rapidity through unknown and untravelled regions, amidst the howlings of a fearful hurricane, rolled about as though revelling in a freedom for which it had long struggled, but of which until that moment it had been kept in absolute ignorance. It at length, as if somewhat fatigued by its exertions, gradually assumed the motions of a snake working its way with astonishing speed toward a given object. During this frightful operation the gas was rushing in torrents from the upper and lower valves, but more particularly from the latter, as the density of the atmosphere through which we were forcing our progress pressed so heavily on the valve at the top of the balloon as to admit of comparatively but a small escape by that aperture.

"'At this juncture, had it not been for the application to our mouths of two pipes leading into an air-bag with which we had furnished ourselves previous to starting, we must within a minute have been suffocated, and so, but by a different means, have shared the melancholy fate of our friend. The gas, notwithstanding all our precautions, from the violence of its operations on the human frame, almost immediately deprived us of sight, and we were both, as far as our visionary powers were concerned, in a state of total darkness for between four and five minutes.

"'As soon as we had partially regained the use of our eyes, and had somewhat recovered from the effects of the awful scene in which from the circumstances we had been plunged, our first attention was directed to the barometer. I soon discovered that my powers had not sufficiently returned to enable me to see the mercury, but Mr. Spencer found that it stood at 13.20, giving an elevation of 23,384 feet, or about four miles and a quarter. I do not conceive, from the length of time I had been liberating the gas, that this was anything like our greatest altitude, for we were evidently effecting a rapid descent.

"'Recollecting the late hour at which we quitted Vauxhall, I now began to be anxious about the time, and on applying to Mr. Spencer ascertained that it wanted not more than a quarter to nine o'clock. From this I was aware, notwithstanding in our then position we were blessed with a magnificent light, that on emerging from below the clouds darkness would have assumed her sable hue over the earth, and that we should have much difficulty, therefore, in ascertaining the nature and character of the country, supposing us to be over the land, on which we must effect our final descent. I consequently became extremely anxious to make our way through the clouds as quickly as possible, which having done, we proceeded until we had reached within some 300 feet of the ground, when we found it requisite, from our inability

to ascertain the nature of the ground, the whole country beneath us offering the appearance of thick woods, to cast out every article of ballast and movable matters, even to ropes and empty ballast-bags, in order to prevent us from coming in contact with what was supposed to be trees. After calling out for some time, and hanging out the grapnel, we heard voices in reply, and the parties speedily drew us to a safe place of landing, which proved to be close to the village of Offham, near Town Malling, seven miles west of Maidstone and twenty-eight from London.

"'At half-past ten o'clock this morning we quitted Town Malling, and it was not until our arrival at Wrotham, at which place I inquired whether they had heard where Mr. Cocking had descended, that I became acquainted with the unexpected and melancholy result of his experiment.'"


HAMPTON'S PARACHUTE DESCENT.

# CHAPTER XX.

Mr. Hampton's ascent from Cremorne House, Chelsea, Thursday, June 13, 1839, and descent with his parachute—Description of his parachute—Aërial nocturnal excursion from Marseilles to Turin by Mr. Arban.

IN connection with the preceding narrative, this contemporary account of a parachute descent by Mr. Hampton is of interest:

"Mr. Hampton commenced his career as an aëronaut at the Eyre Arms Tavern, St. John's Wood, on the 7th of June last, where he met with great difficulties, but his judgment and intrepidity soon overcame them. It was on his ascent afterward at Rochester that he particularly displayed great presence of mind and determined spirit, for on that occasion, shortly after he had left the earth, the wind shifting drove his balloon seaward, and it descended on the ocean, some miles from the coast; while in this perilous situation he clung to his balloon until rescued by a trading-vessel, which landed the aëronaut with his Albion balloon at Whitstable. He ascended next at Canterbury, when, the balloon not being sufficiently buoyant from a want of gas, the intrepid Hampton cut away the car to lighten the balloon, and he ascended standing on the hoop to which the ropes that passed over the balloon were attached, and descended safely. In the course of last summer Mr. Hampton ascended from Cremorne House and also at other places with the greatest facility, and descended without accident. At length he determined to outstrip all competition by descending from his balloon by means of a newly-constructed parachute. The Montpelier gardens, at Cheltenham, was the place chosen for this daring exploit; but the sad fate of Mr. Cocking, and the censure which the proprietors of Vauxhall gardens incurred by permitting the descent from the Nassau balloon, induced the owner of Montpelier gardens to withhold his consent to Mr. Hampton's experiment; but in order to gratify the curiosity of the immense concourse of spectators that were assembled upon that occasion, he consented that the balloon and parachute should be exhibited, but to ascend no higher than sixty feet from the earth, for fear of accident. When Mr. Hampton had reached this altitude, he could not resist the desire he had of putting his parachute to the test, and accordingly severed the rope which passed over his balloon, the two ends being held by men stationed in the gardens for that purpose.

The astonishment of the spectators may be imagined when they beheld the intrepid aëronaut majestically soaring toward the clouds. When about two miles from the earth, he determined upon descending, but unlike Garnerin, who depended upon the atmospheric pressure, Mr. Hampton opened his parachute before he separated it from the balloon. The wind was very high. The balloon appeared, when viewed from below, to be driven along at a great rate; the gale was perhaps the most severe Mr. H. ever experienced, the wind carrying him over the Leckhampton hills with great violence. He was not up more than twenty minutes, and descended at Cobberley. This ascent was in May, 1839.

"The engraving shows the admirable construction of the parachute: the upper part is in the form of an umbrella, and about fifteen feet in diameter, with an ornamented border. The ribs are eight feet long, and expand from the top of the parachute to its extremities; they are formed of very thick whale-bone, strongly fastened by brass clamps; the ribs are connected to the copper tube by stretchers made of bamboo. At the ends of the ribs curtains are suspended two and a half feet deep, and by an admirable contrivance, Mr. Hampton when in his seat in the parachute can by a rope which runs from the car to the curtains either contract or enlarge them, in the same manner as the sailor furls his sails. In order to guard against every possible accident, the car of the parachute is strongly guarded by iron hoops, to prevent the possibility of its receiving injury on reaching the earth. Mr. Hampton while in the car can by a pulley which runs through a copper tube (connecting the balloon to the parachute) open a small valve in the balloon, by which means he can let as much gas escape as he may think necessary immediately previous to his descending. When Mr. H. imagines enough gas is let off, he severs the rope which holds the parachute to the balloon (this rope also is conveyed to the balloon through the tube, which is eleven feet high, the altitude of the parachute), and descends.

"The engraving represents the manner of Mr. Hampton's ascending with the top of the parachute closed, and also as it appears when expanded, with the means by which the gas escapes from the balloon, and his mode of descending, as also that of his balloon, and his reaching the earth at Cobberley.

"The ascent at Cremorne House on Thursday last was a pleasing sight, not so repulsive to the feelings as that of the ascent of Mons. Garnerin some years since.

"Shortly before the ascent, the rain impeded the progress of making the necessary preparation; indeed, for some time it was imagined no ascent would take place. At length, between eight and nine o'clock in the evening, the car was affixed to the balloon; and everything being ready, the undaunted aëronaut gently ascended amidst the cheers of the assembled company. When he had been up a short time, he severed the rope which connected the parachute with the balloon, and descended in fine style, alighting on the Fulham road in perfect safety.

"He was conducted back to the gardens, accompanied by an immense concourse of people, who were not sparing of their approbation of his daring exploit."

Mr. Arban, the aëronaut, ascended in his balloon from the Château de Fleurs (the Vauxhall of Marseilles) at half-past six in the evening of the 2d of September, 1849, and alighted at the village of Pion Forte, near Turin, the following morning, at half-past two, having accomplished the distance—about four hundred miles—in eight hours. The particulars of this interesting voyage, as related by Mr. Arban himself, are as follows:

"I ascended from the Château de Fleurs on Sunday evening, the 2d instant, at half-past six. At eight I was over the wood of Esteret, where I ascertained I was at the height of 4000 metres. The temperature of the air was cold but dry; my centigrade thermometer marked four degrees below zero. The wind was south-west, and sent me over Nice. For nearly two hours I was surrounded by very dense clouds; my cloak no longer sufficed to keep me warm; I suffered much from cold feet. I nevertheless determined to proceed and traverse the Alps, from which I knew I was not far distant.

"My provision of ballast was enough to raise me above the highest peaks. The cold gradually increased, the wind became steady and the moon lighted me like the sun. I was at the foot of the Alps; the snows, cascades, rivers, all were sparkling; the ravines and rocks produced masses of darkness which served as shadows to the gigantic picture. The wind now interrupted the regularity of my course; I was occasionally obliged to ascend in order to pass over the peaks. I reached the summit of the Alps at eleven o'clock; and as the horizon became clear and my course regular, I began to think of supping. I was now at an elevation of 4600 metres. It was indispensably necessary for me to pursue my journey and reach Piedmont. Chaos only was under me, and to alight in these regions was impossible. After supper I threw my empty bottle into the snow beneath, where possibly some adventurous traveller will one day find it, and will be led to conclude that another before him had explored the same desert regions.

"At half-past one in the morning I was over Mount Misso, which I knew, having explored it in my first journey to Piedmont. There the Durance and the Po take their source. I reconnoitred their position, and discovered the magnificent plains of the mountain. Before this certainty, a singular optical delusion, occasioned by the shining of the moon upon the snow, made me at first think myself over the open sea. But as the south-west wind had not ceased to blow, I was convinced by this fact, as well as by others I had noticed, that I could not be over the sea. The stars confirmed the accuracy of my compass, and the appearance of Mont Blanc satisfied me that I must be approaching Turin. Mont Blanc, to my left, on a level with the top of which I was, being far above the clouds, resembled an immense block of crystal sparkling with a thousand fires.

"At a quarter to three Mount Vise, which was behind me, proved to me that I was in the neighborhood of Turin. I determined to alight, which I did without much difficulty, having ballast enough to go much farther. I alighted near a large farm-yard, where I was surrounded by several large watch-dogs, from whose caresses I was protected by my cloak. Their barking awakened the peasants, who were more surprised than frightened at seeing me. They admitted me to their home, informed me that it was half-past two, and that I was in the village of Pion Forte, near Stubini, six kilometres from Turin. I passed the remainder of the night at the farm-house, and in the morning the peasants accompanied me to the mayor, who delivered me a certificate attesting my arrival, etc. After packing up my balloon and car, I set out for Turin, where I arrived at nine in the morning."

In this voyage the aëronaut sailed from west to east, from Marseilles to Nice, a distance of about a hundred miles, crossing the mountains at a point where the Cottian Alps meet and form an angle with the maritime Alps; he was swept along their eastern side in a nearly northern direction. Had he ascended higher, he would no doubt have been carried toward Genoa.

JAMES GLAISHER, F.R.S.

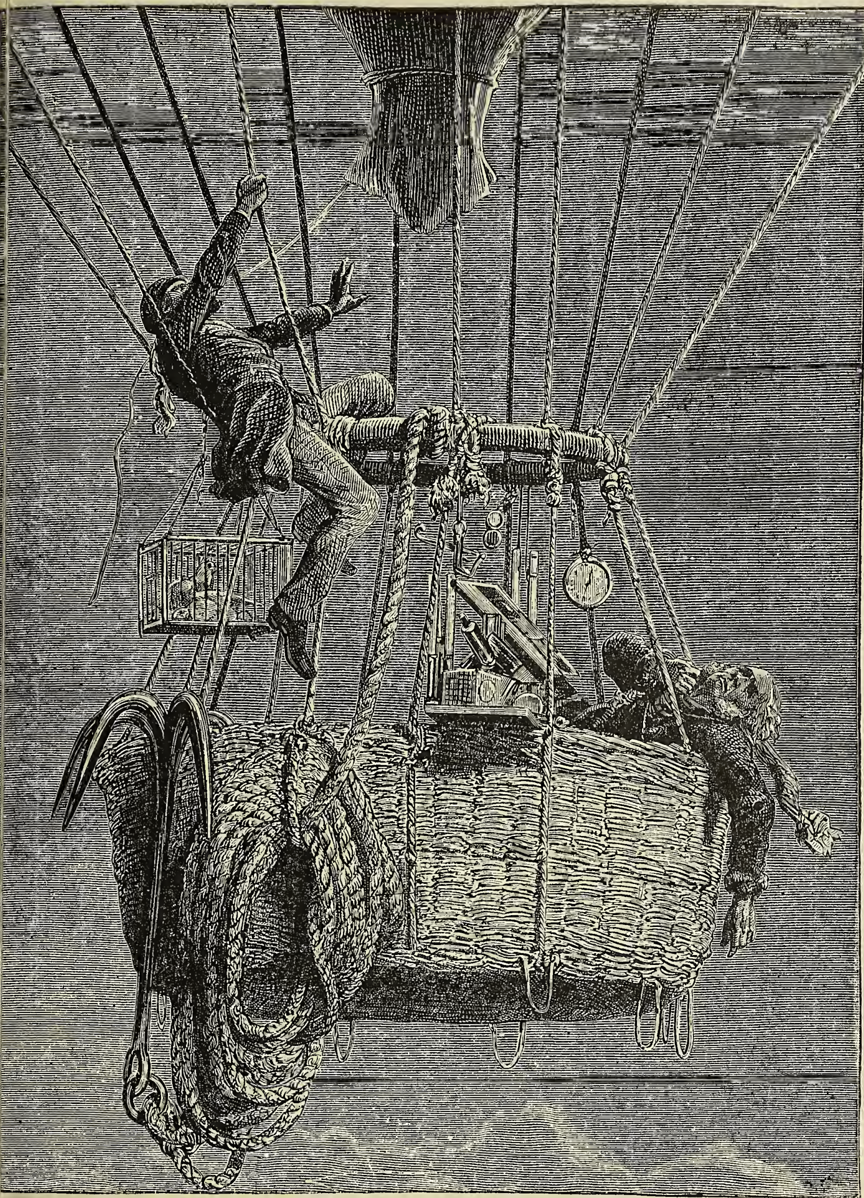
# CHAPTER XXI.

Mr. Glaisher's ascent from Wolverhampton, England, September 5, 1862—The aëronaut insensible at an immense altitude—A height of seven miles supposed to have been attained.

DURING the years 1862, '63, '65 and '66, Mr. James Glaisher made a number of ascensions in England for the purpose of scientific observation. During one of these, made from Wolverhampton, September 5, 1862, he ascended to an immense height. He claims seven miles; but as he was insensible when the balloon was at its greatest altitude, his calculation cannot be accepted as scientifically accurate. Mr. Glaisher's narration of this voyage is as follows:

"This ascent had been delayed owing to the unfavorable state of the weather. We left the earth at 1h. 3m. P. M.; the temperature of the air was 59°, and that of the dew-point 50°. The air at first was misty; at the height of 5000 feet the temperature was 41°, dew-point 37.9°. At 1h. 13m. we entered a dense cloud of about 1100 feet in thickness, where the temperature fell to 36.5°, the dew-point being the same, thus indicating that the air here was saturated with moisture. At this elevation the report of a gun was heard. Momentarily the clouds became lighter, and on emerging from them at 1h. 17m. a flood of strong sunlight burst upon us, with a beautiful blue sky without a cloud, and beneath us lay a magnificent sea of clouds, its surface varied with endless hills, hillocks and mountain chains, and with many snow-white tufts rising from it. I here attempted to take a view with the camera, but we were rising with too great rapidity and revolving too quickly to enable me to succeed. The brightness of the clouds, however, was so great that I should have needed but a momentary exposure, Dr. Hill Norris having kindly furnished me with extremely sensitive dry plates for the purpose. We reached the height of two miles at 1h. 22m., where the sky was of a darker blue, and from whence the earth was visible in occasional patches beneath the clouds. The temperature had fallen to the freezing-point, and the dew-point to 26°. The height of three miles was attained at 1h. 28m., with a temperature of 18°, and dew-point 13°; from 1h. 22m. to 1h. 30m. the wet-bulb thermometer read incorrectly, the ice not being properly formed on it. At 1h. 34m. Mr. Coxwell was panting for breath; at 1h. 38m. the mercury of

Daniell's hygrometer fell below the limits of the scale. We reached the elevation of four miles at 1h. 40m.; the temperature was 8°, the dew-point minus 15°, or 47° below the freezing-point of water. Discharging sand, we in ten minutes attained the altitude of five miles, and the temperature had passed below zero, and then read minus 2.0°. At this point no dew was observed on Regnault's hygrometer when cooled down to minus 30°. Up to this time I had taken observations with comfort, and experienced no difficulty in breathing, whilst Mr. Coxwell, in consequence of the exertions he had to make, had breathed with difficulty for some time. Having discharged sand, we ascended still higher; the aspirator became troublesome to work, and I also found a difficulty in seeing clearly. At 1h. 51m. the barometer read 10.8in. About 1h. 52m. or later I read the dry-bulb thermometer as minus 5°; after this I could not see the column of mercury in the wet-bulb thermometer, nor the hands of the watch, nor the fine divisions on any instrument. I asked Mr. Coxwell to help me to read the instruments. In consequence, however, of the rotatory motion of the balloon, which had continued without ceasing since leaving the earth, the valve-line had become entangled, and he had to leave the car and mount into the ring to readjust it. I then looked at the barometer, and found its reading to be 9$\frac{3}{4}$in., still decreasing fast, implying a height exceeding 29,000 feet. Shortly after, I laid my arm upon the table, possessed of its full vigor; but on being desirous of using it, I found it powerless—it must have lost its power momentarily; trying to move the other arm, I found it powerless also. Then I tried to shake myself, and succeeded, but I seemed to have no limbs. In looking at the barometer my head fell over my left shoulder; I struggled and shook my body again, but could not move my arms. Getting my head upright for an instant only, it fell on my right shoulder; then I fell backward, my back resting against the side of the car and my head on its edge. In this position my eyes were directed to Mr. Coxwell in the ring. When I shook my body, I seemed to have full power over the muscles of the back, and to some extent over those of the neck, but none over either my arms or my legs. As in the case of the arms, so all muscular power was lost in an instant from my back and neck. I dimly saw Mr. Coxwell and endeavored to speak, but could not. In an instant intense darkness overcame me, so that the optic nerve lost power suddenly; but I was still conscious, with as active a brain as at the present moment whilst writing this. I thought I had been seized with asphyxia, and believed I should experience nothing more, as death would come unless we speedily descended; other thoughts were entering my mind, when I suddenly became unconscious as on going to sleep. I cannot tell anything of the sense of hearing, as no sound reaches the air to break the perfect stillness and silence of the regions between six and seven miles above the earth. My last observation was made at 1h. 54m. above 29,000 feet. I suppose two or three minutes to have elapsed between my eyes becoming insensible to seeing fine divisions and 1h. 54., and



GLAISHER INSENSIBLE AT A HEIGHT OF SEVEN MILES.

then two or three minutes more to have passed till I was insensible, which I think, therefore, took place about 1h. 56m. or 57m.

"Whilst powerless, I heard the words 'temperature' and 'observation,' and I knew Mr. Coxwell was in the car, speaking to and endeavoring to rouse me; therefore consciousness and hearing had returned. I then heard him speak more emphatically, but could not see, speak or move. I heard him again say, 'Do try; now, do.' Then the instruments became dimly visible, then Mr. Coxwell, and very shortly I saw clearly. Next I arose in my seat and looked around as though waking from sleep, though not refreshed, and said to Mr. Coxwell, 'I have been insensible.' He said, 'You have, and I too, very nearly.' I then drew up my legs, which had been extended, and took a pencil in my hand to begin observations. Mr. Coxwell told me that he had lost the use of his hands, which were black, and I poured brandy over them.

"I resumed my observations at 2h. 7m., recording the barometer reading at 11.53 inches, and temperature minus 2°. It is probable that three or four minutes passed from the time of my hearing the words 'temperature' and 'observation' till I began to observe; if so, returning consciousness came at 2h. 4m. P. M., and this gives seven minutes for total insensibility. I found the water in the vessel supplying the wet-bulb thermometer one solid mass of ice, though I had, by frequent disturbance, kept it from freezing. It did not all melt until we had been on the ground some time. Mr. Coxwell told me that while in the ring he felt it piercingly cold, that hoarfrost was all round the neck of the balloon, and that on attempting to leave the ring he found his hands frozen. He had, therefore, to place his arms on the ring and drop down. When he saw me, he thought for a moment that I had lain back to rest myself, and he spoke to me without eliciting a reply; he then noticed that my legs projected and my arms hung down by my side, and saw that my countenance was serene and placid, without the earnestness and anxiety he had observed before going into the ring; then it struck him that I was insensible. He wished to approach me, but could not; and when he felt insensibility coming over him too, he became anxious to open the valve. But in consequence of having lost the use of his hands, he could not do this; ultimately he succeeded, by seizing the cord with his teeth and dipping his head two or three times, until the balloon took a decided turn downward.

"No inconvenience followed my insensibility; and when we dropped, it was in a country where no conveyance of any kind could be obtained, so I had to walk between seven and eight miles.

"During the descent, which was at first very rapid, the wind was easterly. To check the rapidity of the descent, sand was thrown out at 2h. 30m. The wet-bulb seemed to be free from ice at this time, but I held the bulb between my thumb and finger, for the purpose of melting any ice remaining on it or the connecting thread. The readings after this appeared correct. The final descent took place in the

centre of a large grass-field belonging to Mr. Kersall, at Cold Weston, seven miles and a half from Ludlow.

"I have already said that my last observation was made at a height of 29,000 feet; at this time (1h. 54m.) we were ascending at the rate of 1000 feet per minute; and when I resumed observations, we were descending at the rate of 2000 feet per minute. These two positions must be connected, taking into account the interval of time between—viz., 13 minutes. And on these considerations the balloon must have attained the altitude of 36,000 or 37,000 feet. Again, a very delicate minimum thermometer read minus 11.9,° and this would give a height of 37,000 feet. Mr. Coxwell, on coming from the ring, noticed that the centre of the aneroid barometer, its blue hand and a rope attached to the car were all in the same straight line, and this gave a reading of 7 inches, and leads to the same result. Therefore these independent means all lead to about the same elevation—viz., fully seven miles.

"In this ascent six pigeons were taken up. One was thrown out at the height of three miles, when it extended its wings and dropped like a piece of paper; the second, at four miles, flew vigorously round and round, apparently taking a dip each time; a third was thrown out between four and five miles, and it fell downward as a stone. A fourth was thrown out at four miles on descending; it flew in a circle, and shortly alighted on the top of the balloon. The two remaining pigeons were brought down to the ground. One was found to be dead, and the other, a carrier, was still living, but would not leave the hand when I attempted to throw it off, till, after a quarter of an hour, it began to peck at a piece of ribbon with which its neck was encircled; it was then jerked off the finger, and shortly afterward flew with some vigor toward Wolverhampton. One of the pigeons returned to Wolverhampton on Sunday the 7th, and it was the only one I ever heard of.

"In this ascent, on passing out of the clouds there was an increase of 9°, and then there was no interruption in the decrease of temperature till the height of 15,000 feet was reached, when a warm current of air was entered, which continued to 24,000 feet, after which the regular decrease of temperature continued to the highest point reached. On descending, the same current was again met with, between 22,000 and 23,000 feet. A similar interruption, but to a greater amount, was experienced till the balloon had descended to about the same height in which it was reached on ascending; after this no further break occurred in the regular increase of temperature, the sky being clear till the descent was completed. From the general agreement of the results as observed by Regnault's hygrometer, and those of the dew-point as found by the dry and wet-bulb thermometers, there can be no doubt that the temperature of the dew-point, at heights exceeding 30,000 feet, must have been as low as minus 50° below the zero of Fahrenheit's scale, or 82° below the freezing-point of water, implying that the air was very dry."

CAMILLE FLAMMARION.

# CHAPTER XXII.

A voyage in two stages by M. Flammarion—Evening—St. Cloud, Versailles, Dreux—Night—Verneuil, Laigle—Descent into the River Orne.

FROM the narrative of the voyages made by M. Camille Flammarion for scientific purposes, the following is selected as a specimen of the French enthusiasm in aëronautics:

## I.

"The ascent on Tuesday, 18th June, 1867, was in a westerly direction from the very moment of our departure. In the evening ascent I was accompanied by Baron de Rochetaillée and M. Eugène Godard; in the night ascent by M. Godard only.

"Though the Arc de l'Etoile may be considered the grandest and most imposing entrance into Paris, the western end of the capital is decidedly the most magnificent for leaving it in a balloon. We get clear of the town at once, and plunge into a region of silence in the first minute of our excursion. We have scarcely said adieu to our friends when we find ourselves over the green coquettish garden of the Bois de Boulogne, with its brilliant ponds of water, and here and there a little white sail like the wing of a swan, whilst the narrow golden-colored paths wind about the great park in elegant and graceful curves. The woods of the various plantations, varying in shade, present the aspect of so many delicately-cut emeralds, darker or more transparent, according to the inclination of the numerous facets. Man alone has not produced this work of art; Nature has also taken her part in it, and animated the whole scene. The green avenues have passed away, and now the celebrated park of the Château de la Muette appears beneath us. Here it was that on the 21st of October, 1783, at half-past one in the afternoon, *the first aërial voyage* was accomplished. Here it was that man first dared to abandon himself to the unknown regions of atmospheric space.

"Some of our readers may perhaps remember that it was not without some difficulty that Louis XVI. would allow this first journey in the air to be made. He feared lest the travellers should be deceived and lost in the unknown regions of the meteors, or that the *Montgol-*

*fiere* which carried them would take fire, and not only destroy their lives, but cause a conflagration along its route.

"The king would only permit the experiment to be made by two criminals condemned to death. But the proud and courageous Pilâtre de Rozier, *the first aëronaut*, was indignant at the idea 'that vile criminals should have the glory of being the first to rise into the air.' He made every effort to ward off such a calamity, and, thanks to the duchess de Polignac, governess of the royal children, he at last obtained permission to make the first balloon ascent with his friend the marquis d'Arlandes.

"It was from the courtyard below us that the aërial fire machine rose and sailed across Paris, and among the witnesses of this extraordinary ascent was Benjamin Franklin. This appears to have happened a long time ago, but in reality it is scarcely eighty years since, and it is just possible that some of our readers may recollect the remarkable occurrence.

"Alas! only two years later this same intrepid Pilâtre de Rozier, accompanied by M. Romaine, lost his life in endeavoring to cross the Channel by means of a fire balloon above which was attached a gas balloon. They were scarcely twenty minutes in the air before the two balloons caught fire, and the unfortunate men were at once precipitated to the earth at some three hundred yards from the sea-side. M. Romaine still showed some signs of life, but Pilâtre de Rozier was completely dead, and all his bones were broken. He was twenty-eight years of age, and engaged to be married to a young lady then at school at Boulogne, who, according to the accounts published shortly after this deplorable accident, could not survive the effect of it, and died in convulsions eight days afterward.

"My memory had scarcely time to call forth these historical details whilst passing over the spot where the first balloon ascent was made by man, than our aërostat had glided over the Château of St. Cloud. We pass over the Seine, and over the private park where the future Charles X. and father of Louis Philippe made an ascent in 1784; it was at a moment when the throne was very unsteady, and it was hoped perhaps that a more solid state of things might be found up above.

"*Apropos* of this ascent made by the duc de Chartres (Philippe-Egalité), the good-natured Madame de Vergennes said that it was neither for love of science nor for the sake of the danger, but simply to place the duke a little above his difficulties; in fact, that it was the only way left of keeping his head above the water.

"We left at a quarter-past five, and in ten minutes our balloon floated at a height of 1970 feet above the Bois de Boulogne. The hygrometer then marked 60 and 61, in lieu of 57, at which it had stood a little time before, and the thermometer had sunk some 7° Fahr. It is probably to the increased humidity of this region that we must attribute the following fact:

"The balloon ceased to rise, and began, on the contrary, to descend

rapidly. In the space of two minutes we threw out no less than forty pounds' weight of ballast, in spite of which we sank from 1970 feet to 755 feet in about three minutes. It was at this slight elevation that we crossed the Seine; the loss of a few more pounds of ballast allowed us to rise slowly to the height of 3543 feet, at which we passed over Versailles.

"Not only is the landscape here, as I said above, one of the most charming, but the country passed over is celebrated in the annals of aërostation. It was from the great courtyard at Versailles that the first attempt at aërial navigation was made, in presence of Louis XVI. and Marie Antoinette, on the 19th September, 1783. To the basket-car of a Montgolfiere, or fire balloon, a sheep, a cock and a duck were attached on this occasion; and I find in the *Memoires Secrets* of Bachaumont a curious letter, dated from Versailles on the 19th of September, in which he says: 'When the car and the balloon were found after the voyage, at Vaucresson, the sheep was grazing quietly, the duck appeared in perfect health, but the cock had broken its head.' I also find in this letter a very curious fact which is not generally known: 'They (the two brothers Montgolfier) had caused all the old shoes that could be collected to be brought here, and threw them into the damp straw that was burning, together with pieces of decomposed meat, for these are the substances which supply their gas. The king and the queen came up to examine the machine, but the noxious smell thus produced obliged them to retire at once.'

"By this time Paris had disappeared in the evening mist; the last glimpse we got of it might be represented by a plain covered with white stones, lit up by the last rays of the setting sun. We have St. Cyr on the right. It is ten minutes past six, and the balloon has turned half round, the sun now being on my right hand instead of on my left, as it was a few minutes before. We pass over the Lake of St. Quentin, and before us we see sparkling the pond of the Château de Pontchartrain toward the north-west.

"The crowing of a cock is distinctly heard; it is a sign of the existence of civilization in the neighborhood; and, in fact, we are just over the village of Notre Dame de la Roche. At present we are gliding over the castle, I suspect, at the slight elevation of 160 to 330 feet, according to the undulations of the soil. Above the beautiful valleys we sail along at a height of about 330 feet, and on passing over the hills we almost touch the trees. We might easily rise to six times this height by throwing out a little ballast, but the aspect of the country is so beautiful this evening that we do not care to do so. Moreover, we have some observations to make in these lower strata of the air with regard to damp and dew.

"The hygrometer rose gradually to 70 as we passed into these low strata, and as the evening advanced. Our velocity has been very variable: 1230 feet per minute at starting; 1263 feet per minute above Versailles; 1017 feet per minute after we had sunk down to

a height of 500, to 1362 feet while passing near Essarts and Villeneux.

"As we come over Essarts, the children are frightened by our appearance, and utter shrieks of terror, the village ducks fly off to a distance, all the inhabitants run out of their houses and follow our course along the side of the pond of St. Hubert, which we are about to cross. 'They are drowned! they are drowned!' is the universal exclamation which we hear from every side as our balloon sails close to the water's edge. The best method of obtaining an accurate estimate of the population of any given district is to cross over it in a balloon; every soul rushes out of doors to look at you, and the people can be counted like marbles.

"The good people of Essarts followed us along the sides of the vast pond of St. Hubert; the deepest curiosity was imprinted upon every countenance. We cannot say whether or not they were disappointed at the non-realization of their prediction, but the fact is that a small sack full of ballast was at this moment thrown overboard, and we rose to 1640 feet at once.

"The most curious experiment that can be made in a balloon when passing over a lake or other wide sheet of water consists in observing the beauty of the echo. No other surface is comparable in this respect with that of water, especially for the purity and sonority of the waves of sound that reach the ear. Every syllable that you may happen to address to the limpid surface comes back again with the utmost clearness and distinctness, whilst much louder noises are devoid of echo from the plains and fields.

"Vast ponds lie to the west of St. Hubert. We leave the town and forest of Rambouillet to the left; at forty minutes past seven we quit the department Seine-et-Oise and enter that of Eure-et-Loire. At four minutes past eight the sun sets, its circular form being much disfigured by atmospheric refraction; the disk appears flattened above and below.

"The winding course of the rivulet prevents our attempting a descent until we arrive at Villeneux. Already many hundreds of the country people have viewed us and are proclaiming our arrival by loud shouts. A handful of ballast thrown out enables us to pass over the village and to glide down quickly on the other side of it, near the gardens which join the houses to the open country. It is now seven minutes past eight, and we have travelled fifty-one miles, nearly in a straight line, from Paris.

"The more important observations to be made on this excursion were reserved for our nocturnal expedition. They were to notice the variation of moisture and temperature with heights during the night; to observe the dawn of day at the summer solstice; the intensity of the moon's light; the brilliancy of the planets; the formation of clouds before daylight, etc. This part of the excursion was to be made alone with my accustomed pilot. But whatever pleasure may

"BUT THE SCEPTRE OF THE NIGHT IS HELD BY JUPITER."

attach to those intellectual researches, the body must also be cared for, and requires substantial support. *Mens sana in corpore sano*, which, carefully translated, meant, 'Let us go and get some supper at Dreux before our next ascent.' Dreux was only two leagues distant, and we already got a glimpse of the sepulchral monument belonging to the Orleans family.

"The inhabitants of Villeneux had been made aware of our intention, and took us along the principal street to the square. The streets here, as in similar old-fashioned places, are lighted by lamps swung upon wires across the road, which rendered the moving of the balloon a somewhat difficult undertaking. We were drawn along by means of a couple of ropes, and in two hours and a half we found ourselves at Dreux. The men who had taken us thus in tow declared that they were rather tired. But I proved to them, by means of algebra and the well-known principle of Archimedes, that they should not feel any fatigue, for the balloon weighs no more than its own volume of air. However, I dare not assert that they were convinced by this argument alone. A promenade of two hours and a half duration in a captive balloon, at eventide and in midsummer, is by no means a disagreeable adventure; and I cannot help thinking that the day will come when, instead of travelling across the desert on the uncomfortable backs of camels, the said dromedaries will have captive balloons attached to them, and the passengers provided thus with the most delicious mode of travelling it is possible to conceive. When we arrived at Dreux, we found that the balloon could not be got into the town on account of the telegraph wires. The men who had drawn us here were therefore requested to bivouac around it."

## II.

"The silver light of the moon streamed over the country, and the vast plane was completely still, as we left the hotel and proceeded to our aërostat, the car of which had been loaded with stones. The men had had no difficulty with it, for the atmosphere was perfectly calm and the balloon had remained quite motionless.

"As soon as it was delivered of the weight which kept it down, it soared quickly into the pure sky. My intelligent pilot poured out the ballast with a careful hand, keeping his eyes firmly fixed upon the barometer as he did so, whilst I gave myself up to contemplation and study.

"We started at twenty-five minutes past one in the morning, just as the moon had reached the meridian, and at two o'clock we were 4725 feet high; the thermometer had sunk from 50° Fahr. to 41°, the hygrometer from 97 to 84, after having stopped for a moment at a minimum of 79, when we were at a height of 2625 feet. The variation in the degree of humidity, therefore, is not the same at night as by day.

"The fact which struck me most during this ascent was the velocity

of the wind or the displacement of the air in connection with the altitude. Generally speaking, land winds (winds on the surface of the earth) are more intense *during the day* than the higher currents, but *at night* it appears that the higher currents are the strongest. But from want of a sufficient number of experiences, I cannot yet assert that this is a general rule.

" On the ground before we started the atmosphere was perfectly calm, but we had scarcely risen more than 328 feet when we perceived that we were being carried along at a considerable speed, which increased the higher we rose. This velocity was thirty-four feet per second during the first hour, and thirty-nine feet per second throughout the next. Moreover, the direction of our route was not the same as in the evening. I may observe that the aërostatic lines followed by balloons, or in other terms the currents of the atmosphere, often appear to form curves which tend to take a west or north-westerly direction.

" At the summer solstice the commencement of dawn and the termination of twilight are very close together. We had scarcely quitted the ground, at half-past one, when we saw quite distinctly the first appearance of daybreak in the N.N.E. The white radiance of the morning aurora showed itself first on a thin horizontal zone of light, neatly terminated at about 15° above our horizon. I never saw a softer and purer light than this. What we were looking at was, in fact, the higher regions of the atmosphere lit up by the rays of the sun, then just over the mid-Pacific Ocean. The celestial whiteness of this approaching daylight was so exquisitely pure that the starlit regions of the sky, though so transparent, appeared as if covered with a leaden-colored veil.

" Some readers may think it strange that the first rays of dawn could be seen at half-past one in the morning in spite of the light of the moon. I was anxious to make this observation during the period of new moon, and on the 30th June, the sky being extremely clear at the time, I followed the faint twilight from eleven o'clock till one in the morning, and saw it pass gradually from N.N.W. to N.N.E. without ever disappearing entirely. At this date the sun does not sink more than 18° below the horizon.

" Being desirous of ascertaining the relative intensity of moonlight and the light of dawn, I compared them every five minutes. It was exactly at 2h. 45m. that both lights were of equal intensity, and then I could read a newspaper turned toward the morning aurora as easily as when it was turned toward the moon. But here a peculiar circumstance presents itself that may perhaps surprise our readers.

" The whiteness of the light of the moon has become proverbial. When compared to that of candles, lamps, etc., the latter appears yellow or reddish yellow; the light of the moon causes even the flame of hydrogen to appear so red that the moon itself is almost blue by contrast. Thus the pale orb of night has become an emblem of purity, and the whitest lily cannot compare its tint to that of Phœbe.

"I was therefore rather anxious to ascertain whether, when surprised by the advent of aurora, the goddess of night was as pure as her reputation held her to be. The experiment was easily made, and the photometer used, one of the most simple kind: some sheets of white paper were exposed to the light of the moon, and then turned toward that of dawn, and this was repeated several times, to enable me to compare the tint and the intensity of the two sources of light. Now, some time before these two lights were of equal intensity, the pure white light of dawn had caused the other to turn distinctly yellow.

"It is perhaps well to observe here that the notes taken in the balloon which form the skeleton of this narrative were written sometimes by the light of the moon, sometimes by that of dawning day, and now and then more or less in the dark. For it is prudent not to carry any description of light in a balloon; the envelope of the latter being open at its lower extremity, the gas it contains may take fire by the slightest spark, and, it is needless to add, the aëronaut would be instantly precipitated to the earth.

"The northern and southern portions of our heavens present two very different aspects. In the latter the sky is deep, transparent and blue; the mist which covers the earth appears like an ocean of fog; the moon rides calmly above the world of watery vapor. In the former the sky appears covered or overcast, and in the north-east terminated in a transparent opening. Directly overhead hangs the enormous dark and apparently immovable sphere.

"The principal spots on the moon's surface could be seen by the naked eye, even the radiating mountain Tycho; with a weak hand-glass I could distinguish the smallest spots. When I cast my eyes upon the fog below, and thought of the winds which range in these higher regions, it was not difficult to realize the difficulties which are met with in observing the celestial bodies from the lowest depths of the atmospheric ocean, and I could not help recalling the obstacles met with in this respect at the Paris Observatory, constantly surrounded as it is by the dust and steam of a large city.

"At twenty minutes past two we sailed to the left of a little square town; at first sight we took it to be an orchard, but on examining it more attentively we recognized some large buildings and a promenade lined with trees. By referring to our map we made out that it was the town of Verneuil.

"At 2h. 55m. we pass over the town of Laigle. Deep valleys in which a slight mist rises are all we can see of its soil.

"It was here above Laigle, in the region of the air where we are now floating, that occurred the first fall of meteorites which was duly investigated by science. It occurred on Friday, the 26th of April, 1803, a little after one o'clock in the afternoon, at a time when the sky was as clear as it is now. Thousands of stones are said to have fallen, and the celebrated Biot brought some fragments of them to the Acad-

emy of Sciences at Paris. Never did a fall of aërolites throw a country population into such a state of fright. Those who heard the explosion without seeing the light of the meteor were astounded by this sudden production of loud thunder in the middle of a lovely day; those who saw the stones hurled down from the skies by some invisible power, falling with a cracking noise on houses, on trees and sinking into the soil, might well exclaim, with the ancient Gauls, that it was 'the fall of heaven.' Nothing less was required to draw the attention of French philosophers in those days to the wonderful phenomena of meteoric stones.

"Our balloon passed through this region so celebrated in the history of meteorology, and continued its flight over the department of the Orne. Venus has just risen, and shines as a bright white star in the golden dawn, and with even purer light than it. Mercury will rise too late to be observed. Mars set before midnight. Saturn creeps down toward the west. But the sceptre of the night is held by Jupiter; I never saw this planet more brilliant, nor has it the slightest scintillation. It appears as bright as the moon and all the stars; even those of the first magnitude are pale in contrast with it. About three o'clock the stars become extinguished one after another. Arcturus is the last to disappear, but the moon and Jupiter still remain visible when the entire celestial army vanishes at the approach of day.

"Since I made this first nocturnal excursion I have often passed the night in the air, as may be seen in the remainder of this narrative, but I never had such fine weather nor so charming an excursion. The temperature was 41° Fahr. at 4921 feet above the earth, two hours after midnight (it was 50° on the ground); at half-past two it was 46.4° at the height of 3281 feet; at three o'clock it was 51.8° at 1312 feet, and therefore *higher* than that of the bottom of the valley into which we descended, and where the thermometer marked only 42.8° half an hour later. Moisture was also now prevalent in the valley.

"The luminosity spread through the atmosphere by the morning dawn is very different from the light of the moon. By means of the latter I could certainly read the indication of the various instruments, and write, nor did we ever cease being able to distinguish the country below—the woods, fields, plateaux and valleys. But this light glides over objects rather than penetrates them. It sketches their vague outline and produces a kind of semi-tinted map. With the light of the morning dawn nothing of the kind occurs; some time before it is equal in intensity to that of the moon, it fills the entire atmosphere and incorporates itself with its molecules. The air, the mountains, the valleys, all imbibe it; it *penetrates* the trees of the forest and the grass of the fields. Everything appears animated by it, and Nature seems to claim it as the universal cause of the life, force and beauty of all created things.

"At twenty-five minutes past three o'clock we came over the village of Gace, and descended into a field covered with dew, at the side of the

little river Touques, which falls into the sea at Trouville. Having allowed a little gas to escape, we came down to the ground, but we scarcely touched it. Some bullocks that were grazing near the spot appeared rather astonished by our descent, and after hesitating for about a quarter of an hour, they approached the balloon. It was a herd of red bullocks; they inspected us for some moments, and then lowered their horns as if preparing for an attack. At this moment a bag of ballast was thrown at the head of the animal nearest to us, causing us to rise some twenty yards into the air, and to spring, as it were, to the other side of the field. No men came up until four o'clock, when some farmers approached and held the car down whilst we stepped out, surrounded this time by another herd of cattle.

"The outspoken reflections which escape from the peasantry, men, women and children, grouped around the car after we have reached the ground, are often rather amusing. Everything in or about the balloon is inspected by them with the utmost scrutiny; the scientific instruments seem to attract their attention in a wonderful manner. The mercurial barometer placed in its travelling case is generally taken for a telescope—'it is used to study the moon'—or sometimes for a gun. The hygrometer is taken for a clock or a large watch, and the reason given is 'because the small hands of ordinary watches cannot move high up in the air.' The aneroid barometer is always put down as a mariner's compass. Even an ordinary drinking-bottle or wine-flask is looked upon as some mysterious astronomical instrument more or less connected with comets, meteors and shooting stars.

"After all, nothing equals the charm of these aërial travels, and at the end of every new excursion I cannot help regretting that this wonderfully easy and luxurious mode of locomotion cannot yet come into general practice."

# CHAPTER XXIII.

War-balloons—The French balloon service during the siege of Paris—What might have been done in the way of making the balloon a means of aggressive warfare.

NECESSITY is the mother of invention, and in nothing has it been more explicitly illustrated than in the use of the mail balloons by the French government in Paris during its investment by the Prussian army. As soon as Gambetta made his triumphant escape from the beleaguered city over the Prussian lines with a balloon, in order to communicate with the outside governmental interests of his nation, the public at large became impressed with the belief that it was not more hazardous to get out of the city by this mode of conveyance than to run the risk of bombardment and starvation, and many persons soon followed the example of the daring minister.

The ingenious mind of the French people halted not at this limited use of the balloon. Soon after this they despatched a daily mail balloon with passengers and mail matter and a few carrier pigeons. As soon as the mail agent landed his freight of mail, etc., he had photographed the current news of the London *Times*, and such other memoranda as might be useful to the Paris government, tied it round the neck of one of his carrier pigeons, which carried it into Paris, there to be thrown upon a screen through a magic-lantern, from whence it was transcribed for the governmental press.

In spite of all the powerful Prussian army could do, this communication between the inside and outside of Paris was uninterruptedly kept up, Krupp's balloon-guns and sharp-shooter rifles to the contrary notwithstanding.

A balloon in the hands of an experienced aëronaut is in no danger from fire-arms. At the height of one or two thousand yards it presents but a small mark; and being in motion all the time, and immediately overhead, a cannon cannot be trained quickly upon it, and rifle-shots are not very effective at that range. Could they be made to reach it at that distance, it would be but the work of a minute to send it a thousand feet higher.

But is it not strange that enlightened and ingenious Paris went no

farther with the balloon? Why did they not use it to drive the Prussians from their close investing lines?

What was there to hinder the Parisians from constructing a balloon of two hundred feet diameter, which, when filled with coal gas from their sufficiently capacious works, would have lifted 167,000 pounds—over eighty-three tons—from which 50,000 pounds would have to be deducted for weight of balloon and ropes, leaving a net carrying power of fifty-eight tons, and this to consist of percussion shells for the demolition of the Prussian batteries, and of pyrotechnical hissing serpents and buzzing rockets, to send consternation into their cavalry and wagon camps, and bagasse to smother the soldiers amongst whom it might fall?

It can hardly be conceived that an investing army would stand such a fire from above, especially in the night. While the enemy below could not see a balloon at night a mile above them, the outlines of their camp would be plainly visible to the counter-besiegers above them. Such a contest could not have been equalled by the Prussians, as the facilities for it were solely inside of the environed city. By extending the mooring-cord so that the war-balloon would stand a mile or two beyond the nearest Prussian forts, the balloon would shift itself toward the neutral ground, and ascend as it was lightened of its ammunition, and then it could be windlassed back to receive another cargo of the destructive material.

The cost of the gas necessary to carry out such a mode of defence and assault would not be nearly so much as the cost of the powder and guns and caissons necessary for ground batteries. Gravitation would give effect to the shot and shell in an increased ratio to that of the powder propulsive force. That is to say, the shell coming from the war-balloon at an elevation of eight or ten thousand feet would be continually increasing its force by an acceleration of velocity, and thus strike its object with an impact energy almost equal to that of a shell striking within a few feet of the cannon's mouth. An ordinary shell and fire-proof ammunition magazine would make but a sorry show of resistance to a hundred-pound bomb-shell dropped upon it from an elevation of ten thousand feet.

Besides the simple mode of action from a war-balloon, it could be contrived to carry an enginery of the mitrailleuse kind that would rake with precision and certainty any camp within two miles' distance from its plumb point on the surface of the earth.

An inland city like Paris ought to be provided with a metal balloon. One of two hundred feet in diameter could be constructed of copper weighing one pound to the square foot, which, deducted from its ascensive power when inflated with hydrogen, would leave sixty-eight tons of lifting power. Such a machine constructed inside of a framework from which to solder it together could be easily inflated by the expansion of a cloth balloon inside of it filled with atmospheric air, and then the hydrogen gas introduced between the inside copper surface

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and the bag of atmosphere, so that as it filled with gas the atmosphere and its envelope would be expelled from its lower orifice. To meet the necessity of the expansion and contraction of gas in the copper warship, it would have to be supplied with an India rubber diaphragm in its lowermost section, which would rise and fall agreeably to the necessity as it occurred.

While these projects find but little encouragement from the common mind, they are nevertheless comprehensive in their scientific and art applications, and cannot in that point of view be argued away; and while they are not at the present time received into the affairs of nations, the writer can only console himself with the reflection of—"The world moves for all that."

I might go on and multiply the uses to which the balloon may be appropriated in war; but as it is an instrument more noble in the use of the arts of peace, I may well leave its war claims to those who delight in the pomp and grandeur of the barbarous profession.

## CHAPTER XXIV.

Remarkable voyage of "La Ville d'Orleans"—Over the German Ocean—Peril of the aëronaut—Descent in the snow in Norway.

ONE of the most remarkable voyages of modern times was that of the balloon "La Ville d'Orleans" during the siege of Paris. The following graphic account of this adventure is translated from a narrative which appeared in the *Courrier des États Unis:*

"The aërial voyage accomplished by the balloon La Ville d'Orleans is one of the most interesting and least known episodes of the siege of Paris. It is at the same time beyond contradiction the most extraordinary of all aërostatic voyages effected up to this day, without excepting that of the English aëronaut Green, who traversed La Manche, and that of Nadar, whose descent was so perilous. The fantastic recitals of Jules Verne offer nothing more startling or more original than the simple and faithful account of the experiences of the courageous *capitaine* of La Ville d'Orleans, M. Paul Rolier, one of the impromptu aëronauts who rendered such valuable services during the last war. On the 24th of November the governor of Paris, being obliged to send the government of Tours a despatch relative to the plan for a reunion of the army of Paris with that of the Loire, gave orders to have a balloon in readiness to start at ten o'clock. Considering the importance of the despatches, M. Rolier had the perilous honor of finding himself entrusted with them. The balloon which was to carry him was twenty-two metres high and eighteen metres in diameter. It was capable of containing 2000 metres of gas, and had been constructed under the direction of M. Gabriel Yon, a man most competent in aërial navigation. At eleven o'clock all was ready for the ascension, and M. Rampont, who always presided at the setting out of balloons, was present to assist. It was pitch dark. A fine rain was falling; and the wind appearing favorable enough, M. Rolier mounted into the boat with a *franc-tireur* (sharp-shooter), who was to accompany him in his trip, and gave the traditional order of '*lachez-tout.*' The balloon darted into the air to the shouts of 'Vive la France,' carrying three hundred kilogrammes of letters, a cage containing six carrier pigeons and a package of government despatches. It attained in a few minutes the height of 800 metres. Paris could still be seen,

with its innumerable lamps. But the great city was soon out of sight; and as it now became difficult to traverse a denser stratum of air which they encountered, it was necessary to throw out several bags of ballast. These bags of ballast fell, without doubt, into the Prussian camp, for these new sort of projectiles were responded to by several reports of fire-arms, but the balloon was out of reach, and attained quickly the height of 2700 metres, which height it kept through the night.

"Cities and villages seemed like agglomerations of luminous points, succeeding each other rapidly between the openings of the clouds. Toward half-past three o'clock a sound, heavy and prolonged, was heard, which the voyagers took at once to be that of a train of cars along the northern line of France. Meanwhile, the sound began to grow louder and louder, and they were surprised at not hearing the whistle of the locomotive which ordinarily precedes the noise of trains at a distance. The stars were already growing dim. They were fewer in number, and the day was beginning to break. A light fog lay over the earth, bright with a thousand beams of earliest sunlight. The first awakening of nature, embraced in a single glance of the eye, offered a spectacle surpassing all that the imagination can conceive or the pen describe.

"M. Rolier resolved to let himself descend naturally, without opening the valve, in order to ascertain the locality and the cause of the noise which he continued to hear. As he approached nearer the earth, he perceived what was beneath to be black, which made him think he must be above a large forest. Then the color became bluish. After examining attentively he distinguished little white spots all over the surface, and thought the ground must be covered with snow partly melted. All this did not explain the murmuring sound, which struck upon his ear louder and louder and puzzled him much.

"The balloon descended majestically, with an indolent slowness, without anything occurring to show the voyagers the cause of the grumbling, which, menacing and continuous, was beginning to give them considerable anxiety.

"In fixing his eye mechanically upon one of these white spots he thought he perceived it move. His whole attention was now absorbed upon it, and he was convinced of the frightful certainty that all these spots were forming and disappearing one after another like the foam of waves. A cold sweat covered him from head to foot. The balloon was drifting along above the sea! Its perpetual roar had been sounding in their ears for three hours. The fog, disappearing in the first rays of the sun, permitted them to confirm themselves in this conviction, and to perceive at a great distance land scarcely visible to the west. Calmed after his first emotion, and having reassured his companion, M. Rolier quietly examined the situation. It was terrible. The barometer indicated only five hundred metres of height, and the balloon, which had lost part of its gas dilated by the solar heat, was

loose and flabby. Beneath in all directions the ocean. In order to have any chance of safety, the escape of the gas must be entirely stopped. M. Rolier, climbing upon the shoulders of the *franc-tireur*, hoisted himself into the cordage, and closed the valve by means of a cord carefully tightened. As the balloon descended again, and as it was also urgent to economize the sand ballast, M. Rolier threw a packet of 'proclamations to the Germans' as food to the fishes of the North Sea. Perceiving several vessels in the horizon, he had the idea of profiting by the eventual approach of one of them to let himself down near it and be picked up by it. A report of cannon fired by a steamship had even signalled the balloon. But while descending it had advanced with a giddy velocity, and had gone beyond the vessel by several kilometres, when the guide-rope commenced to drag in the water. Nothing, in fine, indicates to the aërial voyager the velocity of his progress when he has no fixed point as a limit, for the balloon is surrounded by a current of air which advances simultaneously with it, and which appears immovable, whatever be the velocity by which it is animated. Now the Ville d'Orleans was rushing through space with a velocity which, as could be seen farther off, exceeded forty leagues an hour. The boat was now only a few yards from the surface of the sea, and a moment later a heavy shake produced by a wave nearly upset it. Quick as thought the voyagers tried to draw in the guide-rope, but in vain. A furious wind tossed the balloon, and made it lean over. The foam of the waves dashed over the aëronauts, who then threw out several bags of ballast, and cut the cord by which a packet containing sixty-five kilogrammes of letters had been tied to the boat. Safety was secured at this price, yet they had not a minute to lose. The balloon, relieved of considerable weight, darted into the air with a rapidity most terrifying, for an expansion of the gas was sufficient to cause an explosion. M. Rolier hastened to ward off this danger by opening the valve and letting the excess of gas escape. This precaution was indispensable, for the balloon immediately attained an altitude of 5200 metres.

"Let us say in passing that the packet of despatches thrown into the sea was not lost. The following appeared in the Times:

"'On the morning of the 30th of November, 1870, the Dantzic of Christiansand arrived at Leith (Scotland) with a box containing sixty-five kilogrammes of letters, picked up by fishermen.'

"Meanwhile, the balloon was plunging along through the mist, which was growing denser and denser, and the compass indicated a slight change of direction. It was inclining toward the east, maintaining at the same time a constant height.

"If an observation of the compass is far from being easy for the aëronaut, owing to the constant mobility of the needle, due to the gyratory movement of the balloon about its axis, the observation of altitude presents difficulties quite as certain.

"The barometer perfected by MM. Lion and Guichard resolved

these difficulties in a measure, but another mechanism of their invention, which was applied for the first time on the Ville d'Orleans, permitted M. Rolier to take account every instant whether his balloon was descending, rising or following a horizontal direction. This mechanism consists of a metallic arrow suspended horizontally above the boat, and having a thin sheet of pasteboard attached to each end. When the balloon is in repose or moving in a horizontal direction, the equilibrium of the arrow is perfect. If the balloon rises, the resistance of the air acts upon the sheet of pasteboard, and determines the elevation of the point of the arrow. The contrary takes place when the balloon descends and the air presses from below.

"At this time, as the observation of the barometer had become impossible, owing to the fog and the frost, the arrow indicated to our voyagers that the balloon, constantly losing gas, was gradually descending. They then resolved to close once again the valve, and M. Rolier climbed into the cordage to execute this manœuvre, rendered very difficult by the intense cold, which had frozen the material of the balloon. The thermometer indicated 39° centigrade below zero. The boat was filled with frost, the balloon and cordage literally covered with it. The clothes of the unfortunate voyagers were frozen; their faces and hair were covered with frost, and they were suffering from an intense thirst, due to the rarefaction of the air.

"In spite of their efforts to arrest the escape of the gas, the balloon was still descending. The fog had melted away, and they were struck with the magic spectacle which the balloon offered, covered with innumerable needles of ice, and resembling an immense globe glistening with a thousand rays of the sun and constellated with diamonds.

"To this clearing up succeeded another fog, accompanied by a strange sound, which M. Rolier attributed to the whirlwind of the Maëlstrom, and a suffocating, sulphurous odor which caused him a violent headache and rendered respiration extremely difficult. This phenomenon was due to the electric clouds through which the balloon was passing.

"The observations which M. Rolier had the courage and *sangfroid* to make in these more than critical circumstances have been since made the object of a conference, called together at the Académie by one of the most learned members of that assembly, M. Becquerel.

"As the balloon descended farther and farther, they perceived below them dark spots which seemed like pools of standing water. There might be dry ground, and hope began to revive the heart of the voyagers, when a sinister cracking in the envelope of the balloon warned them of a new danger. This envelope, frozen by the cold of the high regions of the atmosphere, threatened to give way to the strong tension caused by the expansion of the gas in measure as the balloon descended.

"M. Rolier crept up and adjusted the valve to moderate the escape of the gas, which was rushing out violently.

"They must resign themselves to the loss of enough of it to prevent

an explosion, and at the same time economize the precious fluid as much as possible. While he was in the cordage, his companion noticed a movement in the guide-rope which they could not account for, owing to the fog. But upon looking intently, and with a feverish emotion which each understood, although their eyes were fatigued by the steady whiteness of the fog, they thought they could distinguish a black point. In less time than it takes to write it M. Rolier seized the cord of the valve and had his companion get a bag of ballast ready, so as to be prepared for any emergency.

"The black point became more and more distinct. It changed to green. There was no longer a doubt of its being anything else than the top of a fir tree.

"What must now have been the feelings of these unfortunates, for more than eight hours believing themselves given over to certain death, can be better imagined than described. They opened completely the valve and threw the anchor. The balloon dashed against the ground. The boat buried itself in the snow. Rolier leaped to the ground, but the *franc-tireur*, whose leg had become entangled in the cordage, could not disengage it, and the balloon, relieved of the weight of one of the voyagers, dragged the other along with it as it resumed its course. Rolier grasped one of the bags of despatches attached to the boat, but did not succeed in retarding the ascension of the monster, which cracked fearfully and broke like pieces of straw several of the trees which came in its way.

"Finally the *franc-tireur* succeeded in disengaging his leg, and the voyagers let themselves drop from a height of fifteen or eighteen yards. Fortunately, there was a thick body of snow to receive them and lighten their fall, which did them no harm. Rolier got up, seized the guide-rope and tried to stop the balloon, but the cord slipped between his stiffened fingers, and the balloon disappeared in the air with all it contained, comprising the cage of carrier-pigeons, the letters and the edibles. After the first emotion of inexpressible joy caused by contact with terra firma, they proceeded to examine the new situation. The examination was not such as to reassure them very much. After having passed fourteen hours and forty minutes above the clouds, they now found themselves this Friday, the 25th of November, at twenty minutes past two o'clock in the afternoon, alone, without food, without arms, upon a foreign soil. The snow was falling in great flakes, and covered the ground already to the depth of sixty centimetres. A rocky peak of a prodigious height, covered with ice, was before them at the west, and an immense forest of firs surrounded them on all sides. Everything about them indicated a desert region, with no traces of habitation. They resolved to proceed toward the south, and went on thus for some time, with the snow almost to their knees. They advanced painfully, stumbling along and clinging to the branches of the fir trees. Once during that fatiguing journey was the monotony broken by the meeting of three large wolves of fine appearance. They defiled

peaceably along a hundred yards off, without disturbing themselves at all, but not without giving our voyagers very serious reflections.

"After three hours of tramping, M. Rolier, wearied out, sank down upon the ground. The *franc-tireur*, who in the balloon had been without strength or will, had regained his energies on contact with the earth. He made a species of bed with a large branch of fir, and there installed his companion, profoundly asleep. Then he set about hunting up a better protection under which to pass the night, and discovered a sort of abandoned cabin, the roof of which had given way under the weight of the snows, and which contained some hay. Having cleared away the snow, the voyagers buried themselves up in the hay and did their best to make themselves comfortable. Exhausted by fatigue, suffering horribly from hunger and cold, Rolier was a prey to a violent fever which kept him awake for a long time. An aurora borealis spread its strange light over the wild landscape which surrounded them.

"After having slept several hours while his companion watched, Rolier took his turn at this service of safety which prudence demanded, and the *franc-tireur* went to sleep.

"The earliest daylight found them on the start, and their first care was to provide themselves with heavy walking-sticks in the forest, from which they had not yet emerged. While engaged at this they perceived traces of a troop of wolves still fresh upon the snow, so they hastened to get out of this so ill-frequented place, and hurried on in a southerly direction. Soon the track of a sledge and prints of horses' feet in the snow reanimated their courage. They followed this precious guide for three-quarters of an hour, and found an isolated cabin, half buried in the snow, before which was a sledge loaded with hay. Great was their joy, for the absence of snow upon the hay showed that the sledge had been recently loaded, and assured them that some human being was near. Meanwhile, they stopped, hesitating, for the appearance of this miserable hut was not entirely reassuring. What reception would they receive from the inhabitants of this cabin, having one door for its only opening and its windows closed by skins?

"They entered. One large room. Not a soul to be seen. An opening in the roof formed the chimney. Some brands smoking upon the ground gave evidence of the recent departure of the aborigines. In one corner was a bed of hay closed in by four boards and covered by a skin. Before the bed, a pair of wooden shoes, and upon shelves fixed to the wall a few plates and stone jars. To complete the marks of civilization, rather reassuring to our fellow-countrymen, there was a coffee-pot still warm, with marks of coffee on it, a tin kettle of boiled potatoes and a pitcher of sour milk. They were nearly dead with hunger, and devoured a part of the larder of their unknown hosts, not daring to take it all for fear of offending. They made a fire to warm themselves, waiting, not without some trepidation, the return of the aborigines, upon whose nationality they began to indulge the most unlikely conjectures. There was nothing which gave them any clew in this regard. But the

fire blazed away; and thanks to the benevolent effect of the warmth, and the satisfaction given to their famished stomachs, they recovered hope and courage. Their investigations led to the discovery of several pairs of woollen stockings well made, which they were engaged in examining, when they heard a voice outside calling, 'Clas!' 'Clas!'

"They rushed to the door, and perceived two men coming in their direction and leading a small horse harnessed to a sledge. Rolier advanced to meet them, and his salutations were received and responded to in a manner quite friendly. They were soon engaged in a conversation the tone of which was most sympathetic, only the aborigines could not understand a word that the Frenchmen were saying, and they on their side comprehended absolutely nothing.

"It was necessary to have recourse to pantomime. This was a complete success. These excellent *naturels* were eager to serve their guests with the best they had, brought out bacon and sausages, and showed themselves hospitable as possible.

"While the Frenchmen were enjoying the coffee, Clas (the name of one of the aborigines) was examining attentively the torn boots which M. Rolier had set by the fire to dry. All of a sudden, Clas, who had just read the address of the bootmaker, cried out, striking his forehead with his hand, 'Paris, Paris, French!' and the two *naturels* rushed at the Frenchmen, and pressed their hands affectionately over and over again.

"M. Rolier, then calling his wits to his aid, succeeded in making them understand by means of a sketch how he happened to be their guest. More fortunate than Alexander Dumas the younger, to whom they brought an umbrella when, under similar circumstances, he asked in graphic language for some mushrooms, M. Rolier was understood, for his interlocutors responded, 'Ja, ja, balloon, balloon!'

"Meanwhile, he had not yet obtained any precise information concerning the country where he found himself, when, wishing to light a cigarette, the necessary finishing up of the whole repast, he noticed a box of matches which showed him what he wanted to know, by means of its mark. This bore the mark 'Nitedals, Tuenstikkers, Pi Sund, Christiania.' They were, then, in Norway! The 'Ville d'Orleans' had travelled 650 leagues in less than fifteen hours, and had left M. Rolier upon Mont-Lid (Leidfield), at the foot of one of the highest peaks of the Scandinavian Cordilleras, in the province of Thilemarken. Then it had taken its fantastic course and come down definitely one hundred kilometres to the northward of Mont-Lid, of Kroedshered, where it caused a great fright to the superstitious population of that region. According to all probability, the balloon had left France above Dunkirk, coasted along by England, inclined afterward toward the east, and taken the open sea as far north as Sandal, Norway. Then its direction inclined toward the north-east; it dashed through a distance of 200 kilometres, passing above uninhabited provinces of Norway, regions where no human succor could have been within reach of the aëronaut, and which a thick fog had happily kept him from seeing.

"As soon as he had considered a little where he was, without losing a moment he had the brothers, Clas and Harald Strand, carry him in a sledge to the neighboring village of Silgjord. He was all this time in possession of the despatch for the government of Tours, and was hastening forward to make arrangements to have it reach its destination. He started for Christiania, and made the journey of two hundred kilometres in a sledge as far as Hongsund, and thence by railroad.

"The warm reception which was given to the French voyagers, whose miraculous arrival filled the whole country with excitement and enthusiasm, converted this journey into a series of uninterrupted ovations. The following extract from a despatch addressed the 3d of December, 1870, by M. Hepp, French consul-general at Christiania, to the count of Chandordy, then minister of foreign affairs, contains a faithful résume of the demonstrations of extraordinary sympathy for France, of which the presence of M. Rolier was the occasion:

"'It would be difficult to enumerate all the testimonials of interest, both public and private, of which M. Rolier has been the object from the time of his first meeting with the peasants in the mountains till his departure from the capital in the midst of the hurrahs of the populace. Kongisberg, Drammen, Christiania, through which he passed, received him with acclamations. The corporations came under his windows and sang songs in his honor. Distant cities sent telegrams of congratulation. Crowds followed him everywhere. At Christiania the distinguished residents connected with the army, the navy, government, the bar and commerce took the initiatory in *fête de sonscription*, to which were invited the French consul and all the French residents. I have never seen such enthusiasm in the country. It was not only the exultation which a courageous action always excites: there was in the ardor of the songs and the speeches another sentiment besides the one felt toward this young man. It was a sentiment of admiration and recognition for the heroic efforts which France was making at this moment, in whose destiny no country in Europe was more deeply interested than Norway.'

"M. Rolier's first care, upon his arrival at Christiania, was to send the despatch of which he was the bearer by telegram in cipher to Tours. He offered his balloon to the university at Christiana, on the condition that it should be exhibited for the profit of victims of the war, and he authorized the sale of his picture and a commemorative medal made of an alloy in which the metal of his electric tiles formed a part. The proceeds of these operations and the subscriptions started by the Norwegians in favor of the French wounded reached, in three days, 24,800 francs, which M. Rolier remitted to the government at Bordeaux when he went there to render account of his mission. It was in recognition of the brilliant manner in which he accomplished it that he was named chevalier de la legion d'honneur, and officer of the Order of Saint Olaf of Sweden."

# CHAPTER XXV.

Aërial telegraphy—Professor Loomis' project—Matteucci's experiments and conclusions—Balloon observations of the electrical phenomena of the atmosphere —The prospect of aërial telegraphy.

IF the philosophic Shakespeare had known anything about the electrical experiment made at Leyden in 1746, by the celebrated Muschenbroek and his associates, with the jar and wire, it would not seem strange that he made Puck promise that he would "girdle the earth in forty minutes." But inasmuch as the immortal bard wrote his "Midsummer Night's Dream" one hundred and forty-six years before that event, it is evident that he drew his inspiration from another source. Being a spiritualist (if we are allowed to judge from his frequent communion with spirits, ghosts, wizards and witches he introduces into his performances), it was quite compatible to his nature to send fairies upon distant mediumistic missions to be performed with incredible speed.

Prof. Loomis, of more modern fame, proposes now to do this very thing—that is, to send Pucks upon aërial messages, wafted along on purely ethereal lines, if not quite around the globe, at least from one high point to another—from a peak of the Alps to one on a summit of the Rocky Mountains—without the old-fashioned mode of metal wires. Should the favorite theory of telegraphic electricians, of the underground return current, be founded in fact, Mr. Loomis has much upon which to base his hope of success, for his system would be simply a reversal of the problem. If an electrical impulse sent over or through the insulated wire finds its way back through a direct line in the earth in order to complete the necessary electric circuit from the positive to the negative point, or vice versa, there is no scientific reason why his earth-line current, lifted up to the stratum of ethereal electrical high tension, should not seek its correlative tractor poised on the same level, however remote.

In order to test the truth of these direct earth currents, Matteucci made a long series of experiments in Italy in 1863, and he says: "The result obtained from these experiments, many times repeated, with every precaution to secure exactness, was that in a mixed circuit, formed of a metallic line and a stratum of earth, horizontal or as

nearly so as possible, of a length not greater than a kilometer (3281 feet), under a clear sky and with the air calm, there is no proper current of the earth discoverable with a galvanometer of 2000 coils. Yet in a circuit of this length, I have noticed, on days of storm and atmospheric disturbance, sudden deviations under the action of the electric discharges."

The conclusions of Matteucci would seem to be uncertain as criterions upon which to base certain data of cosmical electrical currents. In regard to electrical strata as existent in the higher regions of the atmosphere, I had on several occasions some positive evidence. While rising slowly with a balloon in the higher regions of the atmosphere, and passing from one current up into another, I have found strong electrical action between the balloon and the car suspended beneath. On one occasion, while thus passing from a north-west into a south-west current very slowly, the balloon for a few moments swaying to and fro in the eddy, a sack of dry silver sand was emptied; but instead of the sand falling downward, it recurved upward, causing a well-defined stream of it to pass up and attach itself to the surface of the balloon, where it remained for a few moments, and until the whole craft had completely entered the upper current, when the sand fell down in a shower. There were certainly two distinct electrical strata, one positive, the other negative; but whether as primary electrical conditions of aërial strata, or whether they were resultant conditions springing from the friction of two abrading streams of atmosphere, it is impossible to tell with certainty.

It is scientifically demonstrable that we have electrical and magnetic currents in the earth and in the air, and the endeavor to utilize them in the manner suggested by Prof. Loomis is worthy of the consideration and assistance of a nation that has already given to the civilized world many important contributions for the furtherance of human progress. When Morse's circuit wire from Washington to Baltimore and return, covered with tar rope, was used to demonstrate his plan of a recording instrument, it was not dreamt that a single wire, and this without insulating cover, would answer the purpose equally well, and it was the merest accident that led to the discovery. Trace up for a moment the successive steps of this wonderful knowledge-diffuser. First, Wheatstone's wire, laid underground in glass tubes, acting upon a magnetic needle, so as to rotate it over a disk dotted with symbols expressive of a limited language. Next, Joseph Henry's wire-coil magnet, as worked to ring the church-bell a mile distant from Princeton College. Next, Morse's application of the coil-magnet to his circuit wire from Washington to Baltimore, acting upon a lever point that would make dots and lines on a slip of moving paper. Next, the breaking of Morse's wire over the marsh at Bladensburg, and the ends of the wire falling into the water and producing a good working result of a single wire. Next, discarding covered wire and using glass insulators. Next, the submarine cable, to be worked with a powerful battery. Next, the

application of the electrical torsion balance with reflector and candle, as worked in the French cable. This French cable, it is said in the "Smithsonian Reports," can be worked with a galvanic battery contained in the cup of a Springfield musket percussion-cap. And now Prof. Loomis proposes to send the impulse from the Alps to the Rocky Mountains, not with a percussion-cap battery, but with a powerful one that will lift up an earth-current to his proposed elevated point, and from thence send it on the *aërial line* to its correlative point on a distant point, susceptible of being worked with contact breaker as facile as in the French cable.

This is a lightning-rod on a magnificent scale; and if the ordinary lightning-rod can do what is claimed for it by its advocates—draw the electric force from a distant cloud—there is nothing in the way of Loomis' success. Unfortunately for the certainty of the metallic tractors, their verity of action has been held in abeyance from the days of Franklin and Mesmer down to the present. Electrical authorities are as much in the fog as to the precise mode of action of the subtle fluid as are the scientists upon the "origin of life" in their "protoplasmic" and anti-protoplasmic theories.

Loomis is entitled to a respectful hearing and a liberal appropriation from Congress. There is a deep philosophy in his conception; and should it even fail to establish the successful working of aërial telegraphs," it can hardly fail to develop another important link in the endless chain of electrical phenomena. It would not be more wonderful to talk over from Pike's Peak to the summit of the Jungfrau than it is to whisper over the bottom of the sea from New York to London. We live in an age of intellectual progress, and America, freest of the free, is entitled to stand in the front rank of civilizing peoples.

There is at the present time a most profound articulating development of electro-magnetic action, showing itself in the experiments of electro-telegraphy, that inspires this subject with more than ordinary interest. Those silent imponderable forces recognized in the whole physical domain of nature, and as we use them in the transmission of thought, point most decisively to a future that will be as startling, when reduced to a working system, as any of the scientific wonders that have been evolved within the last century.

We know but very little of the nature of force *per se.* Even its effects in many instances are not clearly traceable by our philosophy; and should Loomis not succeed in sending a distinct message from one point to another in his experimental trial, he will no doubt incite others to engage in the study of the grand and wonderful works of nature.

# PART II.

## FORTY YEARS' EXPERIENCE AS AN AËRONAUT.

# FORTY YEARS' EXPERIENCE AS AN AËRONAUT.

## CHAPTER I.

### INTRODUCTION OF THE SUBJECT.

AS this part of the work is more especially intended to direct the student of aëronautics in his researches, and to enable him to attain that degree of perfection and consequent success in its practice which the art at present affords, it will be necessary to detail such of the aërial voyages of the author as will throw the most light in that direction. Another science, intimately connected, may also be noticed without being considered digressive: it is the science of meteorology. Everything which is calculated to improve the art and afford facilities for its vigorous prosecution becomes auxiliary to it, and should not remain unnoticed. The want of such information and assistance is known to no one better than to the author; therefore its due appreciation, he trusts, will enable him to make this part of the book what he ardently desires it to be —a usefully instructive forerunner, bringing into the field of aëronautics a numerous and effective army of experimentalists, through whom the art will rapidly attain a practical position which will place it in advance of other contrivances for transporting passengers to and from all places on the globe. The very easy manner in which any ordinarily skilful person will be enabled to build a balloon and ascend with it, by the rules and instructions which will be given, will convince him that such expectations of its prosperity are founded upon plain and comprehensive principles. It will be discovered that ballooning is not that mysterious, hap-hazard and dangerous art which it is so universally believed to be. And it will not be sufficient to make the subject merely plain enough to be understood by any ordinary mind, but the reasons why so many more fail in minor experiments than succeed will also be

given. Failures in the incipient prosecutions of experiments very often deter the student from *trying* to go farther, while success in such cases is sure to fire the mind and genius of the operator with a spirit of encouragement and progressiveness. For this reason particular instruction will also be given in the art of making and sending up toy balloons. This will be useful, because the same laws and principles govern these operations as apply to those on a larger scale. Indeed, the toy experiments require a nicer perception of discrimination and calculation to make them terminate successfully than do the larger operations. This very difficulty was the cause of retardation in discovering the means of elevating bodies in the air by atmospheric buoyancy. This same difficulty has, since the discovery made by the Montgolfiers, made many a disappointed investigator abandon the subject, from the belief that it was extremely precarious and deficient in common principles of stability, when but a slight hint in the right quarter would have enabled him to go on rejoicing.

None but an ardent laborer in the art of ballooning can feel and appreciate the want of correct information, and its ready means of acquirement. What few recipes were extant, when the author commenced his first operations, for making elastic varnishes and preparing the muslin or silk of which the balloon was composed, did more to retard his progress than if he had never seen them, because they were not from practical hands. This difficulty was only overcome by close application and a gradual research of many years' practice. In this part of the construction of balloons, an important discovery—the making of an elastic varnish—will be laid before the reader. Its great merit consists in having no affinity for oxygen, and yet a quickly drying property, retaining its elasticity under great changes of temperature, and being free from the dangers of spontaneous combustion, thereby giving great durability to the balloon, and also relieving the aëronaut from the trouble and perplexity caused by the adhesiveness so common to balloon varnishes. Indeed, everything pertaining to the construction of balloons and their requisite paraphernalia shall be laid down in a plain, practically comprehensive manner, in its proper order, so that any one who can read may be able to understand it.

## CHAPTER II.

First balloon ascension in the United States—Durant the first American aëronaut—The author's first ascent—Details of the trip—Conclusions.

THE first aërial voyage in the United States was made by M. Blanchard, a Frenchman, in January, 1793, from Philadelphia, Gen. Washington being a spectator. Gilleo and Robertson, also Frenchmen, were the next after Blanchard. No Americans were engaged in the business until Mr. Durant, an ingenious citizen of New York, took it up after Robertson. He made a number of aërial voyages, which were shortly followed by others made by new adventurers in the art.

When I first conceived the idea of making a balloon, I had never seen an ascension with one, nor had I any practical knowledge of its construction. It will, therefore, be interesting, as well as instructive, to give a particular history of my first experiment in detail. In the spring of 1835, living at that time in the city of Philadelphia, I resolved to build a balloon on a very economical plan. As I intended merely to gratify my desire of sailing aloft to enjoy a prospect that I had ever considered must be grand and sublime, I did not wish to incur any more expense in the construction of a machine than was essentially necessary to such a consummation. My first step was the study of the atmosphere—its nature and its buoyant power. This opened a field of speculative philosophy which was well calculated to cause me to rub my forehead and strain my imagination, being, as I was, a novice in such studies. This naturally led me into the study of pneumatics and hydrostatics, and I was indeed amazed at the immense power the atmosphere possessed in elevating bodies or vessels which were exhausted of air and filled with a substance, easily to be made, that would be from twelve to fourteen times lighter than air. This capability of the atmosphere in elevating bodies seemed to me of such enormous extent that I was almost led to the belief that the very earth upon which we live was floating in an immense elastic medium, on the principle of a balloon. The very moderate size of four hundred feet diameter of a balloon would make it capable of raising two million and ninety thousand pounds when inflated with hydrogen

gas. This would raise up and carry off thirteen thousand men of one hundred and fifty pounds each.

No wonder that the citizens of London became alarmed during the French consular war, when they mistook the appearance of a vast flock of birds coming toward the metropolis for Napoleon's army apparently coming down upon them with this (then new) contrivance.

After I had made myself tolerably well acquainted with the science that governs the art of ballooning, I next sought information upon the *probability* of success, should I undertake the experiment. My first step in this matter was to consult a number of scientific gentlemen, by which means I might learn whether my deductions and conclusions squared with those whom I knew to possess the proper information. The result of this determined me to go on. Accordingly, the material for the balloon was procured, which consisted of fine domestic muslin, such as is used for shirting, commonly denominated "long cloth." It was requisite that this should be made air-tight, or as nearly so as possible, with a varnish that should neither crack nor become adhesive when dried. Having a practical knowledge of the composition and nature of varnishes, I saw in this no inconsiderable difficulty to be overcome. Although the receipt-books abounded with prescriptions for elastic varnishes, and even a few specially for coating balloons, it was evident to my mind, on perusing them, that they were mostly the productions of theoretical minds, or, at least, were not written by practical operators.

The varnish most likely to answer, of all that came under my notice, seemed to be that of "bird-lime." Of this article I procured eight pounds, which, together with the requisite quantity of linseed oil and the common metallic driers used in oil varnishes, composed the varnish for the balloon. The muslin was hung up in the same manner as it is hung up about factories—that is, by its one edge on hooks. It was thus coated over and dried in the sun, and then coated a second time. After the second coat had dried, which took nearly a week, it being in winter, it was cut into properly-shaped segments and sewed together. This being done, it was now taken into a large room, filled with common air, and coated a third time. This stopped up the needle-holes, and to some extent perfected the coating of the whole machine. Upon trial of its capability to hold air or gas, it seemed impermeable enough to answer the purpose of a mere aërial pleasure ride. This method of trying the quality of a balloon consists in merely filling it with common air and suffering it to remain for a day or two in this condition, to see what amount it loses. The machine was twenty-eight feet in diameter, and when half filled with common air, lost about twenty per cent. of it in twenty-four hours, so that its real loss, when filled, was equal to ten per cent. in twenty-four hours, and this was far from what a good balloon ought to lose.

The balloon thus finished, the next step was to procure a network for

INTERIOR OF A BALLOON INFLATED WITH AIR.

its rigging, by which the car and other paraphernalia were to be attached. This was composed of cotton seine twine, and knit by a woman who was accustomed to knit fish-nets, and was the best part of the whole machinery. The car consisted of a basket about two and a half feet in diameter at the bottom, gradually expanding to its top, and was about three feet eight inches deep—by the bye, a very awkward shape, as the sequel proved.

Thus provided, the next arrangement was the procurement of an inflating apparatus and materials for generating hydrogen gas. Fifteen casks of a hundred and thirty gallons capacity each were used as retorts. These were arranged in a semicircular form around a gas-receiver, and made to communicate with it by the gas bubbling up through a head of fifteen inches of water through recurved tin tubes, which connected each retort with the receiver. This being got in readiness, nothing remained but to put the machinery in operation and make the experiment. Having now been at considerable expense, although the strictest economy had been observed, my financial condition did not allow me to undertake the additional expense of materials for inflation, unless it should be based upon some remunerating arrangement. It was suggested by some friends that a public exhibition of the contemplated ascension, at fifty cents admission, would meet the expenditures of inflation. This all appeared very reasonable to me in itself; but from the intimations that had already come to my knowledge of a want of confidence in the public as to my ability of making a successful experiment, I was somewhat discouraged in such an undertaking. Not that I really doubted a successful termination of the affair under a fair trial, but because balloon ascensions, from repeated failures in their attempts, and mobs had become synonymous ideas with a great portion of the people who were attracted by them. Even many of my intimate acquaintances shook their heads in doubt as to its feasibility—indeed, as to its possibility—looking on it, as the mass of the people did, as a precarious, mysterious and not easily to be accomplished experiment. The simplicity of the science itself, together with the confidence of those of my scientific friends whom I had consulted, and who seemed to have as little doubt of its possibility as they had of that of running a steamboat or locomotive engine, was enough to outweigh the forebodings of the timid and skeptical, in my mind; but still, this did not answer to allay popular excitement, which must certainly accompany a public balloon ascension even at that day.

However, all things considered, I decided upon the plan of a publicly advertised ascension, and as a first experiment too, to take place at the corner of Ninth and Green streets, in Philadelphia, on the 30th day of April, 1835. This announcement brought down upon me from many of my friends all the forebodings that timid minds could predict on the anticipation of a balloon riot. "You are going right in amongst the

butchers," said some, "and they are a very determined, rough class of people," besides many other imaginative terrors, of which, had I believed the one-tenth of them, I should have been appalled and driven from my determination. But I reasoned in this way—that if the butchers were so formidable a people, they would be equally effective in protecting me in any lawful calling in which I might be engaged. And so I found it to be the case, too, while fixing up my apparatus, which occupied me several days, during which time I became acquainted with many citizens of the district in which I had announced to ascend, and among them were a number of the victuallers of the place, who tendered me the warmest assistance and encouragement, believing, as they did, that I was at least serious and honest in my intentions, even if not capable of accomplishing them.

The 30th of April turned out to be a blustering, stormy day, and these very people who were accounted as not willing to take any excuse for a postponement or delay of a balloon ascension were the first to advise me to put it off until the 2d day of May, which was accordingly done. This happened to be a day in every respect favorable to the experiment. The balloon was brought upon the ground, and, with the car and network, weighed 186 pounds. The inflation was commenced, and everything went on steadily for three hours, when the time for the ascension arrived, it having been announced for four o'clock in the afternoon. The balloon was little more than half full, which caused many to think it would not be able to carry its freight; but as the balloon was twenty-eight feet in diameter, half its capacity, filled with hydrogen, would make an ascensive power of 575 pounds, so that the question with me was whether it *was* half full. Upon consulting Professor J. K. Mitchell, who was present, and who was my friend and adviser in this matter, he concluded it was sufficiently inflated to carry me up. By the time the car was harnessed on the balloon rigging, another half hour passed away, without the least manifestation of discontent by those who were inside the arena, but with no inconsiderable tumult among the dense crowd that had assembled round the outside, and even they seemed to be more moved by anxiety to learn the result than by a desire to mob the balloon, for, as I mentioned before, they too had come to the conclusion that "*he will go up if he can.*"

Everything being apparently in readiness now, I stepped into the car of the balloon, took in about fifteen pounds of sand in two small sacks, a barometer and thermometer, and then attempted to ascertain the precise ascensive power the balloon possessed. But as everybody around me knew it was my first experiment, and as none of the most considerate could get near enough to the machine to enable me to poise it properly for starting, and those who had hold of the ropes and car seemed to labor under the belief that I was not over-anxious to leave the earth, because they could not understand my intentions when desir-


"I WAS APPREHENSIVE THAT IT MIGHT BE MY LAST VOYAGE."

ing them to hold on to the machine until I had it properly graduated, I was of course bound to submit to their proceedings. Thus, before I could even properly arrange my instruments or make the least calculation of the balloon's upward power—as I could not get them to let it swing by a cord which I had attached to the car for that purpose, some crying "send him up," with powerful efforts on their part to suit the action to the word, while others were equally determined to hold it down, which struggle, however, terminated in a few minutes in favor of the *ascendant* party—with a considerable projectile force added to the balloon, I was in a few moments grazing the chimneys of the neighboring buildings. My first act was to get rid of the two small sacks of sand, which relieved the balloon sufficiently, in addition to a rebounding force it got by the car striking the top of a chimney, to send it over a vacant lot, in which it descended. An individual who happened to be on the spot took hold of the car at my request, and held it steady until I handed out the instruments to another who immediately appeared, and in a few moments an immense crowd assembled round the balloon, it being but three or four hundred yards from where it had started. The scene here presented a mixture of excitement and confusion, without the least disposition of violence toward the balloon, and yet of such a nature as to make it morally impossible to do anything with system or order, and it required an almost superhuman effort to make one's self heard in any words to that effect. After having handed out my instruments, as also my boots and coat, which, together with the sand, amounted to at least eighteen pounds, I roared at the top of my voice, "For Heaven's sake, gentlemen, will you give me a chance to make the ascension?" This seemed to have the desired effect, and a number of voices responded to it in a desire to learn my wants. I told them it was necessary to give me a free space for the car to float in, with but one person to hold it; and if it would not show a tendency to ascend without being pushed up, as it had been in the arena, it was impossible to make the ascension without putting more gas into the balloon. A circle was immediately formed; the car was clear; the person in question had his hand on it; it showed an unmistakable tendency to rise, as it required considerable effort to hold it down; and without further delay, I ordered him to let go, and before I could fairly say "Good-bye, gentlemen," the aërial ship was speeding me rapidly above the reach of obstructions. Now followed a scene worthy the pen of a poet. The first second or two of the balloon's ascent caused a stillness in the immense mass of people below that seemed as though they were fixed immovably to the spot, when all of a sudden the very air began to reverberate with the shouts that followed. The multitude appeared to be as much rejoiced at the result as I possibly could be myself; and I must confess it was one of the happiest moments I ever experienced in my life, for but a few minutes before, from the circumstances attendant,

the success of the experiment for the time seemed to rest upon a very doubtful contingency—that of getting back to the inflating apparatus. Up, up, I soared, almost perpendicularly, to the distance of several thousand feet, when a gentle breeze wafted the machine in a south-westerly direction—the balloon still rising—until it reached a point at the intersection of Market street and the Schuylkill River, which is about one mile and a half from where it started. Here it became stationary, or nearly so, and just at a point where the balloon had reached an altitude equal to its ascensive power, where was also a point of two currents of air traversing each other, the one from the north-east, which wafted the machine thither, being here traversed above it by a current from the west.

Having now lost sight of the great throng of people that surrounded me at starting, and standing over a large city, at least a mile above it, solitary and alone, with a low melancholy murmuring noise rising up from it, the balloon slowly writhing and twisting, as it were, between two contending currents, causing a fluttering breeze around me, while I was standing in the car without hat, coat or boots, looking around, below, above and in every direction, strange emotions pervaded my mind. Grandeur had ever been a delightful theme to me, but this was more than grandeur. All the higher faculties of the human mind became gradually aroused; I was gently awakening from a magnificent dream, casting my eyes upon a scene of reality that appeared far more grand and magnificent than the dream itself; strange feelings were passing through my mind; I felt composed in body, but there was an indescribable commotion agitating the inner man, and it was some time before I reasoned the soul and body into their natural state of equilibrium. Although the atmosphere at this height was cold, the perspiration now began to roll from my forehead in large drops. By a comparison of the previous few hours with the position then occupied, I became enabled to look and reflect in a more natural spirit, but still, the vastness, grandeur and sublimity of the scene around me kept me in a mood far different from what I had ever before experienced. The mind appeared to expand itself commensurately with the magnitude of the scene that surrounded it. Here was an immense community of human beings swarming underneath my feet, sending up a humming buzz from their apparently condensed cells; there, the ample folds of the Delaware were rolling themselves into the heaven-curtained clouds of the distant horizon; above me stood the huge distended balloon, swelled, as it were, in pompous pride of its exalted position, floating like an independent sphere, with its single inhabitant, in the great ethereal ocean of the universe. It was a soul-inspiring spectacle, and one that will never be erased from my mind as long as its faculties shall live.

The balloon was retained in the eddy it had reached for several

minutes, and until it was lightened sufficiently to rise above it, which was done by cutting off and throwing overboard a heavy flower-wreath which had been twined around the car. These flowers, as they fell from the car, were, as I was afterward informed, taken for birds by those who watched the progress of the balloon with telescopes. Besides this, the car was hanging so near the balloon that I was enabled to detach the tin tube which was in the neck of it, and which in this instance was unnecessarily heavy; but as the disposal of the wreath had lightened the machine sufficiently to enable it to rise above the eddy, I did not throw it overboard at that point, and upon consideration found it would not be safe to do so until I should get over a place where no human beings would be endangered by its descent. After the balloon had risen above the lower current and the eddy which invariably exists between two currents, it took off in a direction eastward, nearly on a line with Arch street. This I was enabled to tell by the map-like appearance of the city, the market-houses being in the next street south of it, making a good mark to distinguish the streets by. As I passed slowly over the city, its murmuring noise rose up in modulations of variable intensity, giving it a melancholy musical effect, in some measure resembling the sound of an æolian harp. The current from the west being very gentle, it required full twelve minutes to carry the machine from the Schuylkill to the Delaware, during which time I feasted my eyes upon the panoramic scenery of the city and its precincts, occasionally running the eye along the serpentine folds of the Delaware to where it was lost in the clouds which skirted the horizon all around. The Schuylkill seemed of little interest, when viewed from that height, in comparison with its larger neighbor. When I reached the Delaware, I threw overboard the neck-pipe of the balloon, which made a rushing sound in its descent until it splashed into the water; I heard distinctly the noise of the concussion, although I was over a mile above its surface. As I crossed the Delaware, the view up and down, for a distance of twenty or thirty miles each way, was picturesque and grand beyond conception, and yet more natural in appearance than land scenery. This effect of the river scenery caused a degree of composure in my mind, which until now had been strained far beyond a normal condition, that enabled me to investigate and observe in a more ratiocinative manner. Before this, amazement was the only resultant of all observation on this magnificent planisphere. Although the boats and ships on the river looked very diminutive, still, the scene had the miniature appearance of a natural reality. This was not the case, however, in taking a grand and general view over the whole visible plain beneath, for in such an observation a regularity and exactness developed itself in the scene which gave it more of an artificial than a natural aspect. A perfectly formed circle encom-

passed the visible planisphere, or rather the concavo-sphere, it might now be called, for I had attained a height from which the surface of the earth assumed a regularly hollowed or concave appearance—an optical delusion which increases as you recede from it. At the greatest elevation I attained, which was about a mile and a half, the appearance of the world around me assumed a shape or form like that which is made by placing two watch crystals together by their edges, the balloon apparently in the central cavity all the time of its flight at that elevation, the river each way cut off at the intersection of the upper and lower concavo-spheres. At one time this crevice, if I may so term it, was apparently filled in with clouds all around, while at the close of the voyage the visible horizon was clear of them, which gave it, as I before stated, a very artificial appearance. I could not help but think at the time that had the Roman Inquisition which made Vincent Galileo recant his doctrine of the rotundity of the earth in favor of the planispheric theory occupied my position, they would have insisted to his swearing that our earth was hollowed or concave on its outer surface, instead of flat, as they made the philosopher swear it was.

After I had crossed the Delaware and reached a point five or six miles on the Jersey side of it, I made preparations to descend, as I discovered the balloon was now gradually sinking, from the loss of gas through its imperfection, which made me feel as sorrowful as Adam when he was expelled from the garden of Eden. After being in the upper regions of the atmosphere one hour and a quarter, I made a safe descent near Haddonfield, a village about nine miles distant from Philadelphia, and returned home that evening, where I received the congratulations of many friends.

Now that I had really enjoyed the pleasures of an aërial voyage, viewed the earth from a point in space which was isolated and unobstructed, feasted my eyes upon one of the most interesting and richest scenes that mortal man could imagine, and had acquitted myself in an experiment publicly announced in a creditable manner, it might have been supposed that my desires and ambition in this matter had been fully satisfied. But such was not the case. I had now visited the shrine where nature is revealed in its most sublime phases, and its attractions were seductive. I had dreamed a magnificent dream which I felt convinced could be realized. Such were my reflections when recurring to this event. Although many of my friends desired me, in the most persuasive manner, to give up the idea of repeating the experiment, looking upon it as an extremely dangerous business, I resolved in my own mind to pursue it as long as it afforded me the same enjoyment which I experienced in my first essay. Besides, I formed an opinion that aërial navigation was destined to move with the progressive order of the day, and I felt it a duty devolved upon me not to let it sleep for

want of active investigation, however slow its improvement might be. Such considerations induced me to go on, and on I did go, as the sequel will show, for nearly forty years, with at least well-founded hopes of its approaching general usefulness, if not with considerable improvement in the way of having simplified the art, so as to bring it within the reach of experimenters at a reasonable cost and a certainty of success that must ere long give it a practical value.

## CHAPTER III.

American aëronauts—Death of James Mills—Difficulty in the construction of balloons—Author's second experiment—Failure, and its cause—Hints to aëronauts in such predicaments.

ABOUT this period (1835) a considerable number of experimentalists in ballooning made their appearance in various parts of the United States, but, unfortunately for the progress of the art, the most of them were not philosophically acquainted with the subject. For this reason did so many fail in the simple process of a balloon ascension. This had a tendency to confirm the opinion which previously existed—that to make a balloon ascension was a very mysterious and difficult matter. The most successful of this numerous corps of aëronauts were Mr. James Mills, of Baltimore, Mr. Richard Clayton, of Cincinnati, and Mr. William Paullin, of Philadelphia. These gentlemen made a great number of ascensions in various parts of the Union, and Mr. Paullin extended his operations into South America and the West Indies. Mr. Mills died at York, Pa., just as he had announced his eleventh ascension, and it was generally reported that he had come to his death by suffocation from gas. This opinion originated from the fact that he was found dead in the room where he had his balloon, and where he died from apoplexy while in the act of repairing it.

All these aëronauts labored under the same difficulty which gave me so much trouble and perplexity during the first five or six years of my operations—the want of an elastic varnish which should at once combine the qualities of impermeability, elasticity and non-adhesiveness. From this difficulty I did not suffer so much with the first balloon I made, because it was composed of domestic muslin—a fabric which is more capable of absorbing varnish than silk is; but it created a disadvantage in the immense weight of the machine, which was four times the weight of one of silk of the same dimensions. Cumbersome and imperfect as this first machine was, I used it in six experiments before I abandoned it. My second trial with it was from the same spot where I had made the first, but I failed in getting the balloon sufficiently inflated, from an accident that occurred while filling it, from the breaking of a carboy of vitriol, which splashed some acid over the balloon, and damaged it

so much that it could not be repaired sufficiently on the ground to make it answer for the ascension then to be made. This would not have occurred had the balloon been farther from the inflating apparatus, as it might easily, had I used a longer conducting hose to pass the hydrogen from the receiver to the balloon—a precaution which I afterward invariably adopted. Upon this accident occurring, and when all efforts on my part had failed in overcoming the difficulty, I candidly stated to the audience assembled what the reality of the case was; and when they saw that my heart was as full of sorrow as the balloon *should* have been full of hydrogen, they not only sympathized with me, but unanimously resolved not to take back the fee of admission, which I proffered them, and, moreover, cheered me by requesting me to repair the balloon and try it again on some other occasion.

This was all done in the arena in a spontaneous but systematic manner, and I mention it as an instance to show that at even a great gathering of people to witness a balloon ascension, they are not unreasonable nor evil disposed toward the aëronaut when they are convinced that he is guiltless of any intention to deceive them. And when the aëronaut is in such a predicament, it is an easy matter for himself, or any friend of his, to explain things satisfactorily, which is always better than to look upon the public as an uncivilized and vicious throng, and under such delusion attempt to skulk from anticipated vengeance which has no real existence. The very act of attempting to sneak from such responsibility carries with it a degree of suspicion calculated to inspire mistrust, and has caused the destruction of more than one aëronaut's property, when a little common sense would have saved it, and his credit too.

Having devoted this short chapter mainly to an unsuccessful experiment which had been attempted as a public balloon ascension, it may be very properly concluded by advising all experimentalists in ballooning—and it pertains equally strong to all progressive experiments, whether for public amusement or pioneering trials never to promise more than they *really* intend to accomplish. The observance of this rule has saved me a good deal of trouble.

## CHAPTER IV.

Author's third experiment—Perilous situation—Balloon bursting—Descent and its incidents—Woman more presence of mind than man—Two more experiments—Sixth and last experiment with muslin balloon—Unfortunate result—Near proving fatal.

THE third experiment I made was full of interest as well as instruction to the student of aëronautics. On this occasion I attained a very great elevation, and the balloon used was a very large one. Upon the size of the balloon depends the altitude to be attained, and this machine, requiring to be but half filled in order to carry its passenger with considerable ballast, was capable of attaining a height in the atmosphere where the air has but half the density of that on the surface of the earth. Such a height was attained on this occasion; and although the ascension was a most complete and satisfactory one to all who witnessed it, there were defects in the rigging of the balloon which developed themselves in the high and rarefied regions of the atmosphere that placed me for a while in a very perilous situation. The ascension was made from the town of Lebanon, Pa., on the 4th of July, 1835, and the weather was extremely warm.

At three o'clock P. M. I left the earth with a breeze from the northwest. In a few minutes after, a panoramic view of innumerable villages, with the broad dazzling sheet of water of the Susquehanna, was unfolded to the view. I crossed the Reading and Harrisburg turnpike at the first gate below the town; and although I started off with an ascending power that raised me more swiftly than was the horizontal velocity of the wind, I was induced to part with a bag of sand of about six pounds' weight, as a proffer to the toll-gate keeper, who very humorously hailed me to pay toll as the balloon passed over his gate. This caused the balloon to rise with amazing rapidity, rushing up through the strong horizontal wind, which was blowing with a speed of at least thirty miles per hour, and giving the occasion much the appearance and spirit of that in which a fiery charger is dashing along in mettled pride, heeding no restraint. This soon brought me in contact with a thick, hazy mist, which was entered, and in a few moments passed. Above this were a clear sky and brilliant sunshine, but so cold now that my

hands became numb and a painful ear-ache seized me. The balloon was still ascending rapidly, and my next desire was to discharge gas and lower into a more congenial climate, but in this I was foiled, and up boomed the buoyant courser with unabated vigor. The cord by which the valve was worked was sufficiently strong to perform that office, but no allowance was made in its appropriation for unforeseen necessities, such as slight entanglements with other parts of the balloon rigging. getting into folds of the flaccid part of the balloon, which latter casualty occurred on this occasion, and deprived me of the use of that all-important regulator.

Having now got far above the mist, and not less than three miles above the earth, in a temperature of 43°, having been within twenty-five minutes transferred from a warmth of 94°, which the thermometer indicated when I left the earth—the world below scarcely visible, from the intervening discolored stratum of air, my ears buzzing like a bee-hive, which for a while I took to be a commotion of the gas in the balloon endeavoring to escape through its tightly distended envelope, the valve-rope broken off inside the machine, the aërial ship still bounding and gyrating upward—I felt a degree of excitement that can be better imagined than described.

All this difficulty arose from a want of practical knowledge of the art which must be acquired in this as in any other business before we can avoid consequences arising from such deficiency. In the first place, the valve-rope was too frail in this machine. Instead of a substantial cord (cod-fish line I find the best), this was only common seine twine. The car was also rigged too near the balloon; this may have been observed already by the intelligent reader, where it is mentioned in the account of the first voyage that the car was so near the balloon that I was enabled to untie the neck-pipe in the lower orifice of it. On this occasion I had it hanging at least three feet lower from the balloon than before; but when I got to a height in the atmosphere where the gas sustained but half the pressure it did at the time of leaving the earth, it naturally dilated accordingly, and all the part of the balloon that was flaccid when it started was now required for its increase of bulk. For this increase the space within the cords and network between the equator of the balloon and the concentrating hoop above my head to which the car was hanging was insufficient. Having no way to let off gas, even the lower orifice of the balloon containing the neck-pipe, which answers for a safety-valve when properly rigged, being doubled up between the concentrating hoop and the lower side of the balloon, which was now swollen to its utmost tension, I endeavored to reach the lower part of the balloon with a knife, but even by straddling across with my feet in the open-work of the basket it could not be reached by at least two feet. From the hissing noise of the gas which was making its way through the small channels of the compressed neck of the balloon, I

knew that something must give way soon. As I did not know at that time that so large a surface of fabric as is contained in a machine of that size would inevitably meet with friction enough, in falling through the atmosphere, to bring it to a velocity where an acceleration must cease, and *that* at a point where its speed will not cause serious consequences from contact with the earth, I was apprehensive that it *might* be my last voyage.

In another moment a report like that of suddenly bursting an inflated paper bag such as boys frequently amuse themselves with informed me that the balloon had rent, and at the same time some of the cords—two of them—separated from the concentrating hoop, and that side of the balloon at which this took place as quickly bulged out and immediately the atmosphere round the machine got filled with a whitish filmy vapor. This was the consequence of a mixture of warm hydrogen with cold atmosphere. The hydrogen in a balloon is always warmer than the surrounding air when the sun is shining on its globular surface. The explosion was caused by the neck-pipe being pressed between the concentrating hoop and the lower surface of the balloon, and this pipe being tin, and pressing also against two of the net-cords which were brought to an angle by being forced out a little by the muzzle of it, caused them to break at the same time. Although the breaking of two cords next to each other out of the twenty-four—which was the number in this machine—did not seem to endanger my situation much, but seemed rather to have relieved me to some extent from the very precarious condition in which I had been a few moments previously, it still destroyed that mathematical strength existing in its complete state which made me feel anxious to return to terra firma. I looked at my watch, and found the time to be five minutes past four.

After the explosion of the lower part of the balloon it commenced a tolerably rapid descent; and as the atmosphere had got considerably clearer than it had been when I started, I could more easily distinguish the face of the country beneath. On observation, I found the balloon was gradually descending on the village of Womelsdorf. Here I received a salute from a volley of musketry by a company of volunteers who were celebrating the national birthday at that place. Although I had determined to let the balloon sink to the ground as soon as it possibly would from its own gravitation occasioned by the loss of the gas through the rent—for I had no control of the valve—this salute of firing and shouting inspired me to rise again, and accordingly papers and ballast were thrown overboard sufficient to send the machine up at least two miles high. No sooner was this height attained than it again commenced to descend very gradually, which brought me to the earth about four miles west of Reading. Here an incident occurred which was as amusing to me as it was terrifying to the individual who was a party thereto. Being likely to descend in a cluster of trees, I threw out some

ballast to cross them ; at the same time the grappling hooks took hold in a branch of one of the trees, which was broken off and dragged along. At this moment I perceived a countryman mounting the top rail of a worm-fence about a hundred paces ahead of the balloon, to which point the wind was driving it. I hailed him to assist, for the balloon was floating the length of the grapple rope above and dragging the limb of the tree along below. He looked in every direction but upward, and in another moment the limb and grapple came square up against the panel of fence upon which he was sitting, and threw it down, pitching the man headforemost into the meadow before him, from which he sprang terror-stricken, if fleetness of foot is any evidence of such feeling, for he was soon out of sight, leaving me to manage the best way I could, which was by being driven up against a woods. Here I got the help of two women who had been working in the hay-field, and who promptly came to my assistance when I called them, although they were much excited, having never seen such a contrivance before, as they informed me. Had it not been for these Amazonian ladies, I should inevitably have gotten into the woods, for a brisk gale was just passing over at the time.

Thus ended a voyage, after having been in the atmosphere one and a half hours, full of interest, excitement and a great deal of instruction. So far were these difficulties from discouraging me that they, upon the other hand, inspired me to go on and correct the deficiencies in my apparatus.

In the following August I made two ascensions with this same balloon from Reading, Pa., neither of which was of importance enough to need detailed description. The first was cut short from a want of sufficient ascending power, making the duration of the flight short in time and but four or five miles in distance. The second was similar to the first. This balloon, being a very inferior one from the beginning, had now become even worse. Its repairs and its recoating made it very cumbersome, and rendered it impossible to give the satisfaction due the citizens of Reading for the very liberal encouragement they extended to me on the occasion.

Having realized money enough from these ascensions to build a silk balloon with in the coming winter, I determined to make the last experiment with the muslin machine on the 1st of October following, from the city of Lancaster. It now weighed over two hundred pounds without the network and car, and it required as much gas to raise it with a man in it as a silk balloon of the same size would require to carry two individuals, or it took as many cubic feet of gas to raise this machine from the ground alone as it would take to raise a silk one with a passenger. A silk one of the same power weighs from forty-five to sixty pounds, and is in every respect preferable to one of different material. The expense of inflating this cumbersome machine was almost double

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that of a silk one, to say nothing of the advantages in easy management a silk balloon possesses over a muslin one.

Having announced a public ascension from the city of Lancaster for the 1st of October, I took the precaution of having an abundant supply of material for generating a large quantity of gas, being desirous that nothing should occur to prevent the occasion from being satisfactory in every respect. But in this I was doomed to disappointment; and a relation of the cause will be useful to those who may become engaged in similar experiments. The day for the ascension turned out to be a fine clear one, with a strong wind from the north-west, and everything connected with the inflation and preparatory arrangements went off in a satisfactory manner; and when the time had arrived for the ascension, the balloon was filled to an extent which gave it an ascensive power of a hundred pounds more than the whole weight it was required to raise, enabling me to carry a quantity of ballast that would secure me in choosing a place of descent, that might require a dozen of ups and downs during the voyage. Thus provided, everything was got in readiness for a start; and when the machine was released from its moorings, it required the strength of four men to keep it from being dragged along by the force of the wind. The arena being on one side of the street, and a range of two-story buildings on the other, it was necessary that the balloon should rise with a motion equal in velocity to that of the wind, in order to clear the tops of the buildings. And it was also necessary, in order to accomplish this, that the balloon should be detached at the right moment, for the wind would press the balloon down, so that it would stand at an angle of 45° with the car; and if the car should be released at such a moment, it would swing like a pendulum, and before the balloon could attain a sufficient elevation to clear obstructions it would be dashed against the buildings. All this I was well aware of, and mentioned it to some of the persons to whom I confided the charge of the car when about to start; but as the sequel will show, they were very near having me "killed with kindness." The chafing, tossing and plunging gambols of the balloon, when it was only restrained by the holding of the car, soon produced the like, or at least corresponding, actions and emotions in a great portion of the audience and those who had charge of the car, and several times the machine dragged all those who had hold of it halfway across the arena, when they as often took it back again to the place from where I desired to start. Seeing now that the excitement increased with the wind, I found the sooner I should start the better, and I struck upon this plan: two strong cords were tied to the basket at a quarter of its circumference apart; each of these cords was six feet long, and held by two men; by these the whole machine was restrained, and the order for starting was this—when I cut the one cord it was the signal to let the other go, as I could not cut them both at one time.

I now watched the moment when the balloon was rising in her vibrations caused by the gale, and at that moment cut the cord, but the other two, instead of being punctual in letting go theirs, clung on to it until the machine dragged them along with several others, who quickly seized hold of it on seeing its furious career, until they were brought up against the side of the enclosure next the houses, where they all let go just at the moment when the balloon was most depressed by the gale; the consequence was that the car was dashed with a tremendous swing against the eaves of a two-story house (I was on my one knee at the time, or I should most certainly have been pitched to the ground), severing the cords on the side of the basket which struck, letting that side down and *spilling* me out on the very apex of the house, stunned by the concussion.

In a few moments I recovered my senses. My first impressions were like those of awakening from a dream; but on getting up on my feet over the apex of the house, the shouts of the vast concourse of people below soon woke me into stern reality again. Looking up in a south-easterly direction, I beheld the balloon plunging furiously into a chasm of dense black clouds. Thus ended the experiments with a machine that had given me much more trouble than reputation as a skilful aëronaut.

## CHAPTER V.

Abandonment of the old and construction of a silk balloon—Spontaneous combustion of oiled silk—Strange coincidences—Their causes—Ascent from Lancaster with new balloon—Comments on it—Effects of the sun above the clouds—Experiments on echo—Rising and falling through the cloud stratum—Final descent at night—Balloon moored to Mr. Stump's house—Terrific explosion of balloon—Persons injured by it—Accident to the aëronaut—His return home.

HAVING now abandoned the muslin balloon as an aërial ship, I procured a lot of silk to build a new one with. But as it is not stated in the previous chapter what became of the old machine, having left her at a point in the clouds, it will be no more than justice to her history to give her final exit. Having risen to such a height in the atmosphere that the dilatation of the gas filled the whole cavity of the balloon, and its ascending power being capable of carrying it up much beyond that point, the expansive power of the gas of course burst it. From the appearance of some green foliage of trees that was in the car when it started, having turned black, it must have attained an immense height in the atmosphere; for having a six-inch neck-tube in it which was open when it ascended, it rose to a much greater altitude than that at which it became completely filled by diminution of atmospheric pressure. It descended near Bordentown, a point north of east from Lancaster, about seventy-five miles distant.

During the winter of 1835 and 1836 I constructed a new balloon of twenty-four feet diameter and of a pear shape. The silk was of a kind termed India sarsenet; it was white, and in sixty-yard pieces. This silk was coated with a varnish composed of linseed oil and gum-elastic (caoutchouc). The gum-elastic was dissolved in spirits of turpentine, which was afterward boiled up in drying oil. After I had the silk coated twice, and it had become seemingly very dry, the segments or gores for the balloon were cut out in readiness for sewing them together. A dozen of these were cut out, rolled up and laid on a pile in a dry loft, where they had remained from one morning to the next, during which time spontaneous combustion had so far progressed that in a few hours more from the time I discovered it the pile would have

been in a blaze, and no doubt would have set the building on fire. A portion of the gores had already become a putrescent mass, emitting heat and smoke, and were rendered useless. This liability has proved fatal to many an aëronaut's balloon, and it is one which I have entirely overcome, as will be seen under that part of this work which will treat of the construction of balloons.

This machine was finished in the spring of 1836, and was named the "Meteor;" and lest the coincidence of its fate with its name and that which occurred during its manufacture should be misconstrued by superstitious reasonings, as was attempted at the time, it is well enough to state here that the very circumstance of spontaneous combustion in the silk suggested the name which the balloon received. The sequel will show that this machine ended its career in a globe of consuming fire. Besides this, two members of my family dreamed that this machine took fire while sailing aloft, and even advised me to abandon its use while finishing it, for some of the silk which was in the damaged lot was used in its construction. Now, I looked upon it that these dreams and forebodings were suggested, or rather took their origin, from the same cause as did the name of the balloon—the spontaneous combustion of the silk in question. The smell and smoke that arose from it filled these two persons with alarm and apprehension of fire in connection with balloons, which naturally engendered such dreams.

The "Meteor," being completed, was found upon trial to be thoroughly air-tight—an essential quality in a balloon. The citizens of Lancaster, desirous of having an aërial experiment on a most liberal scale, contributed an amount of money, so as to have the ascension free, from the common. Accordingly, an invitation was extended to the people of the county to witness the spectacle on the 7th day of May, 1836.

Everything for the occasion being got in readiness, the day arrived. I will now quote from the newspapers of the day the account of the operations as far as stated by them, considering them impartial historians of facts that transpired under their conductors' eyes:

"On the afternoon of Saturday last a most brilliant balloon ascension was achieved by our townsman Mr. J. Wise from the common near the head of West Orange and Chestnut streets. The circumstances under which this truly splendid ascension was accomplished entitle it to honorable mention and particular commendation.

"The day was extremely disagreeable; a succession of showers, ushered in by the morning's dawn, and continuing with intervals of most undesirable brevity, left but little reason to induce the belief that an attempt would be hazarded—much less that, if made, it would be successful. Occasional glimpses of sunshine only served, like hope deferred, to make the heart sick, for they were invariably and rapidly succeeded by pelting rains. Notwithstanding all these apparently insurmountable obstacles, Mr. Wise persisted in his determination to attempt an ascension,

and at the meridian hour, his intentions having been announced to the public and spread like wildfire through the city, the crowd began to assemble. By three o'clock the ground was pressed by the feet of many thousands, and amid the war of the elements the process of inflation was commenced. From the state of the atmosphere this necessarily proceeded but slowly, but the impatience of the vast assemblage was properly restrained, and their curiosity gratified from time to time by the letting off of a number of small *untenanted* balloons, one of them of most fantastic shape (Flying Dutchman), and whose aërial gambols were productive of infinite diversion.

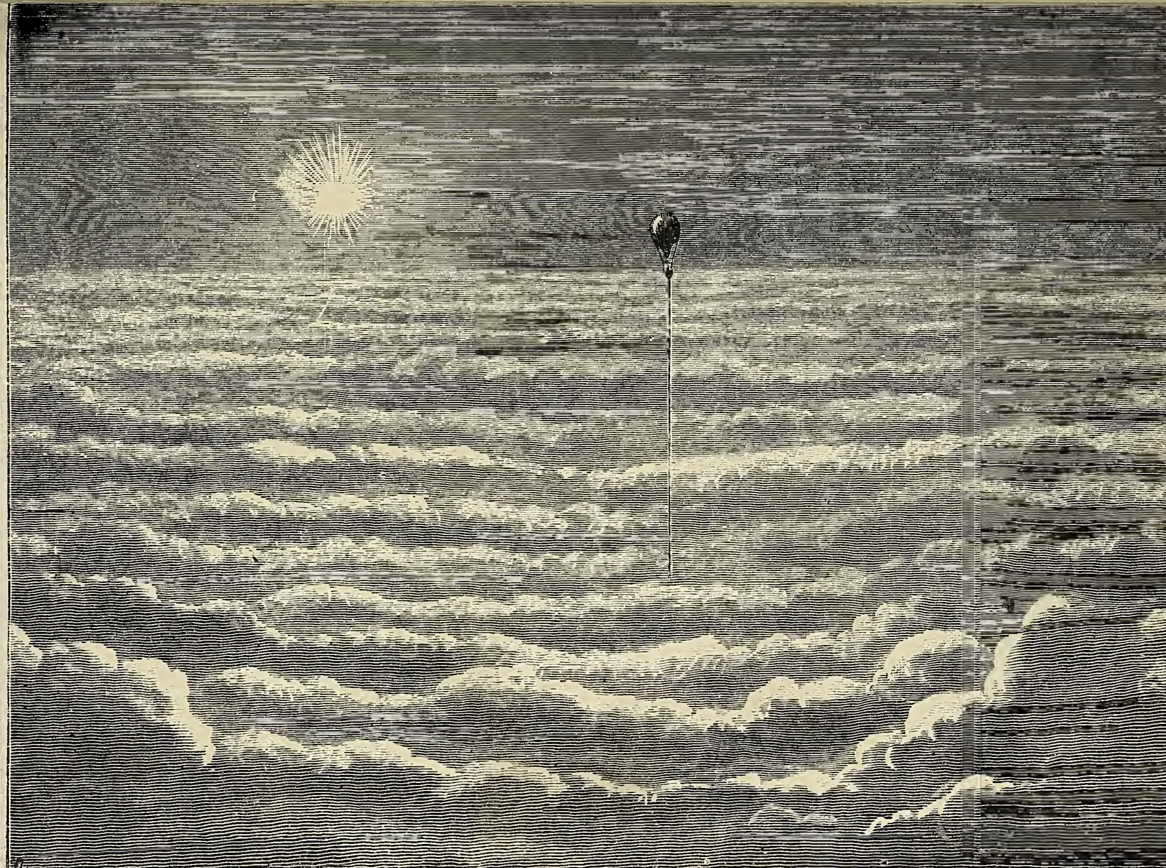
"Soon after five o'clock, the rain having ceased and the balloon being properly inflated, the intrepid adventurer calmly took possession of the frail vehicle prepared for his reception; the glittering ball rose slowly and majestically above the ocean of heads; the cords which bound it to earth were severed, and amid the waving of hands and the shouts of the multitude winged its way to the regions above.

"As it rose, Mr. Wise was discovered standing very composedly in his little car and acknowledging the salutations which accompanied his departure. The balloon rose steadily upward for a few minutes, then shaped its course in a direction nearly south of east (in nautical phrase), and in something less than a quarter of an hour slowly entered the yawning chasm of a huge black cloud, at an immense height, and apparently hovering over a surface of the earth many miles distant from the starting-point. After this the good people of Lancaster beheld him no more.

"Mr. Wise has not yet been heard from, nor can it be satisfactorily ascertained that he has been even *heard of*. As might be expected, rumors are rife; serious apprehensions are entertained for his safety, as his course was nearly direct for the Chesapeake, but we hope for the best, and trust that next week we shall have the pleasing intelligence to announce that he has returned to the warm welcome of his many friends.

"Since the above was in type we have received the Philadelphia Public Ledger of yesterday, which says that Mr. Wise arrived in that city on Tuesday. At half-past eight o'clock in the evening of Saturday last he let off the gas and descended near Port Deposit (Md.). The anxiety manifested by the citizens to give him assistance placed the lights brought by them in contact with the escaping gas, which immediately exploded, causing the entire destruction of his splendid balloon, instruments, clothes, etc., and so severely burnt and injured Mr. Wise that he is now confined to his room in Philadelphia."

The following is an extract from another of the Lancaster papers concerning this ascension: "The balloon ascension on Saturday last, unfavorable as were the circumstances under which it was accomplished, was one of the best we have ever seen. The heavens were



"A VAST CIRCULAR OCEAN OF SNOW."

overhung with clouds 'from early morn till dewy eve;' there was a continued succession of drizzling showers during the whole day, and the air was so saturated with moisture and (apparently) so 'heavy' that there were few, we imagine, who did not feel strong doubts of the ability of the aëronaut to accomplish his object. The interest excited in behalf of Mr. Wise, however, was deep and general. He was surrounded during the whole process of inflation with a friendly and sympathizing crowd, among whom were many of our most respectable citizens. The hostility of the elements and the gloom of the day were in a measure counteracted (to the aëronaut) by the kind assistance of some, by the good feeling and forbearance of all.

"The atmosphere being really *lighter* and less favorable to the evolution of gas than in clear weather, and a greater quantity of hydrogen being required for the same reason, the inflation of the balloon necessarily required a longer time than was anticipated. It was, therefore, half-past five before the process was completed. Without further loss of time, and with the coolness and self-possession of a veteran in his dangerous vocation, Mr. Wise stepped firmly into his car, quickly adjusted and regulated his ballast and appliances, cut the cord, and was rapidly borne upward amid the loud 'godspeeds' of an immense and gratified assemblage. The course of the balloon was directly south, the aëronaut standing up and waving his hat as long as he continued in sight. His 'vessel,' however, soon plunged into the clouds and disappeared. Above, we have no doubt, a kinder sky and a bright and genial sun threw light and warmth over his aërial path, and compensated him, by the splendors with which he was suddenly surrounded, for the gloom which attended his departure.

"P. S.—No certain tidings have yet been received of the aëronaut. Rumor has landed him near Belle Air, Maryland, about forty miles distant, but such does not appear to be the fact."

Having now given the disinterested testimony of the journals of the day of this experiment, as far as their immediate observation enabled them to do so, leaving me, as it were, entering into a world which was divided from the one I left nine minutes before by a thick barrier of clouds, the remainder will be related from notes kept by the way.

In about two minutes after I entered the cloud stratum the balloon emerged from the top. Just as it was penetrating the upper surface of the stratum, I found the cloudy vapor quite warm, and immediately on emerging from it this warmth was increased to a degree of temperature above that of comfortable feeling. A pungently stinging sensation was also produced upon those parts of my person which were exposed to the sun's rays. This I attributed to the hydrogen which was let off while passing through the clouds, some of which hung to me in passing through it. Having started with considerable ascensive power, and having nearly one hundred pounds of ballast in the car, a certain

quantity of gas was discharged while passing through the clouds, which was intended to counteract, in a measure, the increased ascending velocity the balloon would attain as soon as she would get under the direct influence of the sun's rays above the stratum. Notwithstanding this precaution, as soon as the barrier was passed, the balloon in a few moments after sped up at a furious rate until it reached a height at which the barometer stood at nineteen inches and the clouds appeared at an immense depth below me. Not experiencing much warmth by the reflection of heat from the clouds at this distance above them, and the balloon now moving in an angular direction from that of the clouds, their upper surface, lit up in a brilliant white light, gave it the appearance of a vast circular ocean of snow rolling along in a wave-like motion in the most majestic grandeur, and the cold, frosty state of the atmosphere from which it was beheld rendered this *snow scene* most impressive.

I next discharged gas until the barometer stood at twenty-three inches. At this height, it being but a short distance above the cloud surface, I found the temperature very congenial, and continued the rest of the voyage, varying by barometer from twenty-three to twenty-two inches. In the rise and fall of the balloon above the clouds, which occupied twenty minutes, it described a spiral circle; and on coming near to the surface of the clouds, I recognized a familiar tune of martial music, which I afterward learned was the very tune played by the musicians of the city battalion of volunteers, who on this occasion formed a cordon around the ascension ground, they being invited to attend and participate in the enjoyment of the spectacle. An opening in the clouds which occurred for a moment also developed to me a watercourse below, which I took for the Conestoga. My course now lay, as near as I could judge, toward the south, but in order to be more certain concerning my whereabouts and direction, I discharged gas and darted down through the clouds; but when below them, the country appeared so rough with forest hills, and the space between the hills and the lower cloud surface so shallow, that I quickly threw out some ballast, which sent me up again partly into the clouds. Hearing a cow-bell and the sounds of a woodchopper's axe, I hailed in the following manner: "Halloo!" to which I heard the reply, "Halloo!" I next inquired, "How far is this from Lancaster?" which in a few moments was returned by "*How far is this from Lancaster?*" Believing this to come in response as an inquiry to know whether I wished to learn that fact, "The distance to Lancaster," I repeated again in very measured accent. This was again responded to in like measured accent, apparently to my mind as an intent of mockery. Being in the clouds, and unable to see things either above or below, I felt somewhat nettled at such clownish display of wit, and in a very audible tone of voice, while the foregoing was still reverberating on my ear, sung out, "You are a

fool!" which in a very few seconds was answered in an equally distinct and measured tone of "You are a fool!" when it suddenly flashed upon my mind that it was the echo of my own voice, which opinion was ratified by the dying reverberations of "you are a fool," which had now become as numerous as though a whole regiment had caught up the watchword and was passing it in quick succession through the whole line. Involuntarily I exclaimed to myself, "Fooled, sure enough." Being determined to find out my whereabouts, I let off sufficient gas to get below the clouds, when I observed through a spy-glass a little clearing in which was a cottage, and before it a man. His face was turned upward, apparently drawn in that direction by the dialogue I had with myself, and which no doubt he had heard. I inquired of him whether he saw me, for I was then standing up in the car and waving a flag to draw his attention. He answered, "Yes; who are you?" I replied, "An angel of light." Upon which he cried out, "Is your name Wise?" To this I responded, "Yes; how far is this from Lancaster?" to which he answered, "Sixteen miles," upon which I bade him "good-bye," threw out some ballast, and went up through the clouds again. As I was passing up, I heard him say, "God bless you, man!"

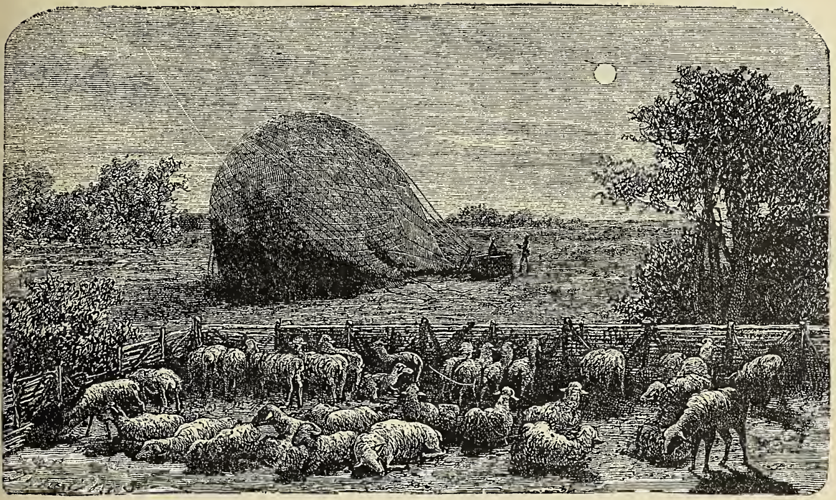
Having now become interested in this singular phenomenon of echo, I continued making experiments in it. I found, when sailing some hundred feet above the cloud stratum, that the echoing sound was short, not near so sonorous or musical to the ear as when in the clouds or immediately beneath them. Still, I could hear the reverberations until they blended into mere undulatory sounds. When at a considerable elevation above the clouds, one or two thousand feet, I could discern no echo, and the report of a rifle was short and sharp; so also the sound of a bell and the chopping of an axe. From these experiments I think one loud clap of thunder, occurring when a dense stratum of clouds is extended over a great portion of surface, is sufficient to cause that long continued rumbling thunder which we often hear, one echo inducing another, until by multiplication they become so numerous as to blend into a mere rumbling vibration in which it is neutralized and lost, as are the waves which are caused by throwing a stone into water.

The wind just above the cloud region appeared to be vibrating from various points of the compass, causing the balloon to describe a kind of zig-zag course in a southerly direction, necessarily making the progress in that direction somewhat slow for aërial travelling.

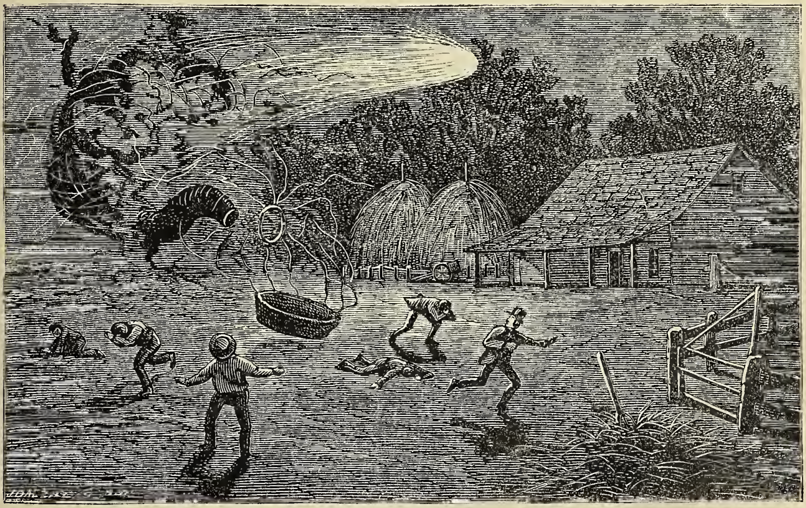
Knowing my course would carry me on the bay shore, and having been aloft nearly two hours, it was evident that I must be nearing the Chesapeake, unless the balloon was making a different course from that of her first sixteen miles. Consequently, another gradual descent through the cloud stratum, which was still very dense, was made, which brought the machine over Conewingo Falls in the Susquehanna River. The roaring noise as it met my ears while yet in the clouds gave me

some foreboding that I had reached the bay shore, taking the noise of the falls for that of the bay surf. My anxiety was relieved from this and increased in another quarter; for in coming through the clouds, the falls were immediately underneath me, the balloon descending very rapidly, and the opposite side of the river lined with highlands and trees, and it was not until a great quantity of ballast was discharged that the balloon overcame the obstacles. I hailed some individuals living at the falls, who invited me to descend and partake of their hospitality, which, however, the position I was placed in compelled me to decline. Before I made this reconnoissance the sun was near the horizon above the clouds, and when my vessel got below them, I found the earth shrouded in a gloomy twilight. The Chesapeake lay some miles to the south, and the direction the balloon was making would carry it along its western border. The large quantity of ballast discharged in crossing the falls caused the balloon to rise to a great height above the clouds, bringing, as it were, the sun above the horizon also, which but a few minutes before was sinking behind a bank of clouds, and had now become elevated twelve to fifteen degrees. This phenomenon interested me more than it deceived me, but was still the cause of keeping me aloft until it had got dark below, which circumstance cost me my balloon and a most terrific accident.

Seeing now, at even that height, that the day-god was fast sinking in the cloud horizon, I commenced a gradual descent, and before I reached the upper surface of the clouds the sun was lost behind their western bound. The descent through this vaulted ceiling of the earth was dark and gloomy in the extreme. A deathly silence, equalled only by the impenetrable darkness that surrounded me on all sides, made the descent awful, and yet grand and imposing. As soon as the clouds were cleared, a few scattered lights were visible, which apprised me that I was coming on land, and in a few moments after I felt my drag-rope, which was four hundred feet long, glide gently over tree tops, and in a few moments more I felt, by its motion, that it was dragging apparently over smooth ground, and heard at the same time human voices not far off. The grapple-iron was immediately thrown out, which quickly brought up the vessel near a fence. Having hallooed considerably while descending from the clouds to the earth, and hearing no response, I next betook myself to loading my car with stones which were within my reach. Having accomplished this in a manner sufficient to keep the balloon anchored by the car in case the grapple-iron should slip its hold, I commenced hallooing again, and my call was immediately answered by a colored man, as I judged from his dialect. He cried, "Where are you?" I answered, "Here, with a balloon." He replied, "I know dat." This surprised me, and I cried out, "How do you know it?" He answered, "I smell de balloon." This surprised me still more, but he, having in the mean time come up to me, informed me, upon in-



"I LANDED BETWEEN BELL-AIR AND PORT DEPOSIT."



"MAKING A REPORT LIKE A PARK OF ARTILLERY."

quiry, that he had helped to fill a balloon at Baltimore the fall previous, and that as soon as I told him I was there with a balloon, he concluded I had come from Baltimore with one, having no doubt of what I told him, because he smelled the hydrogen. Uneducated man as he was, I found him one of remarkably quick perceptive faculties, and just such a one as an aëronaut is glad to meet with on his descent. He informed me that I had landed between Belle-Air and Port Deposit, on the plantation of Mr. Stump, in Harford county, Md. By his assistance the balloon was moored near the house of Mr. Stump, when we roused the family, they having retired to bed at an early hour. Here we found plenty of assistance, Mr. Stump giving me a very cordial reception, at the same time ordering his colored men to render me all the assistance necessary. As it was drizzling and the grass was wet, I determined to discharge the gas from the upper valve of the balloon, and thus be enabled to fold the whole machine into the car beneath it, as it gradually collapsed. This process being necessarily slow and the atmosphere very humid, it became impregnated with the hydrogen for some distance around the balloon. Being some distance from the house, and having a lantern standing at least fifty feet from the balloon, I apprehended no danger from the escaping gas. Things went on in this way until the balloon was emptied to within a thousand cubic feet of gas, her upper end being now drawn down and one of the men with his hand pressing open the upper valve, while I was standing at the other end carefully folding the loose silk into the car. While thus engaged, Mr. Stump standing about thirty feet behind me, and some half dozen more persons near and round the machine, either the lantern, or some other light which had in the mean time been brought to the scene, ignited the explosive mixed atmosphere that was hovering around the balloon, making a report like a park of artillery, throwing me violently back at least ten feet from where I was standing, setting fire to the clothes of some and severely scorching the faces and hands of others, and even Mr. Stump did not entirely escape the effects of it, although a considerable distance from the machine.

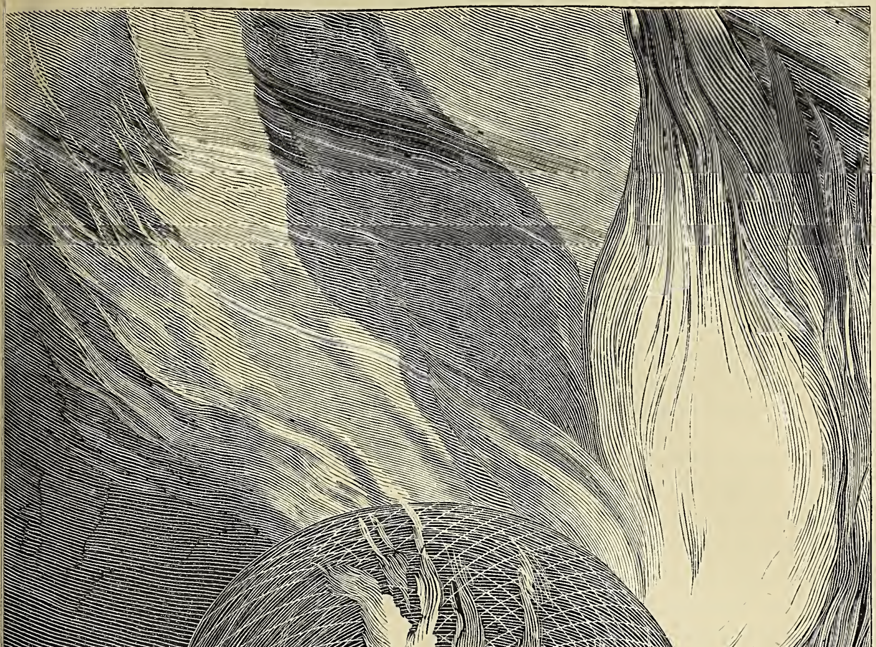
I quickly sprang upon my feet again, and jumped on to the remainder of the balloon, which was burning in the car, and which was thus extinguished by tramping it out; the gas that had by the sudden explosion been liberated from the balloon in the mean time rose rapidly into the air "like a consuming fire," with a rushing noise, until, at a considerable height, it was totally consumed like a dying meteor.

There I stood in deep reverie, scarcely able to realize the events of the last few hours, with feelings like a person awakening from a dream, in which all the magnificence—sublimity, solemnity, terror, consciousness of approaching death that the human mind is capable of conceiving agitated my thoughts, for at the moment of the explosion the death pang flitted through my mind. In a few moments I was

aroused from my fixed position by an agonizing pain through my whole body, which soon concentrated itself in my hands and face. I felt as though the very heart's blood was oozing through the skin, the watery fluid of the system was oozing out in profuse drops, and some of the poor negroes had fared no better than myself in this respect, which their agonizing screams too plainly told. Mr. Stump, who was more of a spectator than an immediate sufferer in this terrific affair, being a very considerate gentleman of advanced years, came up to me and desired me to accompany him to the dwelling, for by this time I had become almost totally blind, and moreover began to feel very sick from the excruciating pain caused by the burns. It also pained me that I had been the cause of Mr. Stump's men being burned, but he, on learning this, begged me not to trouble my mind about that. He also extended me all the care and comfort my condition required, and the following morning, at my earnest request, I was furnished with a vehicle to take me to Port Deposit. Here I had my burns dressed, and on the following Tuesday morning left for Philadelphia, much against the advice of the physician who attended to me at Port Deposit, and reached Philadelphia on Tuesday evening, where my family resided at the time, with my hands and face very much swollen and inflamed. By dint of blood-letting, wholesome diet and the constant application of cooling cataplasms, I was out in ten days afterward with a new skin on my hands and face, determined to make a new balloon, feeling satisfied in my own mind that all my sufferings were overpaid by the experience I had gained in the adventure.

On my arrival in Lancaster I met with a most honorable and hospitable reception, as well as with the means, supplied me by a voluntary contribution of the citizens, to procure a new balloon. Thus ended an experiment which had taken me through an ordeal that was well calculated to make impressions on my mind that will never be erased while living, and to which I invariably recur with the most vivid sensations of satisfaction, painful as were *some* of the exciting incidents connected with it.

As an illustration of the danger incident to bringing fire near an inflated balloon, I may mention the destruction of an air-ship belonging to Mrs. Graham some years ago. This lady ascended from Cremorne Gardens, London, and after a short but tempestuous passage she alighted at Booker's Fields, near Edmonton, at night. The descent was accomplished safely, but at some risk, and the lady, having procured assistance, commenced to empty the balloon, holding the valve wide open. A man happened with a light inadvertently to come behind the lady to see what was going on. The escaping gas instantly took fire, and the effect of the sudden combustion of about ten thousand cubic feet of gas is described as being terrific. Mrs. Graham was severely scorched, and her clothing was nearly destroyed. A number of persons were badly burned, and the balloon was entirely consumed.




DESTRUCTION OF MRS. GRAHAM'S BALLOON.

# CHAPTER VI.

Promptings of the author's profession—Spirit of development—Construction of a new balloon—Its failure—Abandonment of the art for a year—Mr. Cocking's fatal experiment—Report of it in the United States—Causes the author to make another ascent—Account of same—Balloon inflated with coal gas—Newspaper extracts of the occasion—Particulars of the experiment—Successful termination.

HAVING now completely recovered from the accident that had befallen me in my last experiment, and feeling as though I had been fully initiated in a most fascinating art, I firmly resolved to make it my future profession. The scanty knowledge that was in existence at the time concerning aëronautics, leaving the few persons who were engaged in the art to grope their way through an unexplored region without a guide—even without well-directed theoretical instructions—also had a tendency to bring me to such a resolution. How could it be otherwise to an observing and investigating mind? A vast field of science lay open to the investigation of man. It required him but to lay his hand upon the lever of the atmosphere, and elevate himself into and above the region of clouds, where a new life, a new spirit, a new world of science and art, developed itself to his searching imagination. Geography, topography, natural philosophy, atmospheric phenomena, meteorology, astronomy,—all assume new phases. The ability to explore the surface of the bottom of the ocean would no doubt be a grand privilege. The ability to make a super-mundane voyage—to sail above and below the cloud-vaulted canopy of the sky, to glide through nature's rain and snow-making laboratory while in full tide of operation, lit up with electric lights, the facility of soaring above these scenes, while the harmless thunder *rattles* beneath you, and the zig-zag coruscations of electricity look like sparkling diamonds shooting athwart snow-banks, your vessel all the while moving with a smooth, apparently motionless, but grand and majestic pace—twenty, forty and not unfrequently eighty miles per hour—is even a greater privilege. But it is not yet properly—nay, it has not yet begun to be properly—appreciated; the human family has not yet been initiated in this grand prerogative. The day of steam-power transition must attain its acme; then the new-born art will be seized upon, and be made to run a career that will

leave railroad and steamboat transition as far in the background as they have left the stage-coach and horse-boat.

This epoch is fast approaching. The ultimatum of steam transition is nearly reached; the introduction of a more facile mode of travelling is becoming the theme of the age, the pole star of genius; the present century will enjoy its great advantages—its world-civilizing effects. Such is the spirit of this unexplored subject. With such a field in view it was a sufficient apology, a sufficient stimulant, for even a humble searcher in progressive science and art to take upon himself a voluntary pioneership in the exploration of a new and promising estate which has been opened to the human family.

Had I been content with the mere knowledge of constructing a machine by which we can attain an elevation and flight in the atmosphere, my labor on the subject would have ceased with the knowledge I had now acquired. But there it did not, could not, rest; that simple part of it wanted improvement. A balloon capable of remaining in the atmosphere three or four hours was but an imperfect machine, compared to what it ought to be in order to make experiments that would give the subject a consideration worthy of its magnitude. I might have gone on well enough in merely making balloons and balloon ascensions as a matter of novelty and amusement, but the mind in its progressive spirit yearned for a more extended and useful application of the art. And yet to undertake this in a professional way, depending upon public forbearance while prosecuting the subject under public patronage as a source of popular amusement, had before it many difficulties. A failure in what should be announced as a public exhibition was almost a certain signal for the demolition of the unfortunate aëronaut's property, with no small degree of condemnation on his head as an impostor. And yet under these foreboding auspices I launched out into the world with the new business, determined to experiment in the way of improvement as I went along, let the consequences be what they might; and although this determination frequently brought me into most embarrassing predicaments—often into feelings of intense chagrin—still, through an experience of nearly forty years in this profession, I never met with any attempt to injure my property or person, but on the other hand with encouragement and praise when I succeeded, with sympathy, kindness and forbearance when I failed. This obligates me to give to my countrymen and the world all the knowledge I have acquired in the practice of the art.

As the last used balloon had been coated with a solution of gum elastic, which had made it very impermeable to the hydrogen, I determined to coat the next one with the same substance, prepared in a different manner. I dissolved the gum by heat alone, not knowing at the time that under such a process it loses all its elastic property, which it never regains after being melted. It even loses its elasticity to a great

extent when dissolved in spirits of turpentine. And thus far there is but one solvent for it known under which it resumes its elastic property when used as a varnish, and this will be treated of under the head of balloon construction in this work.

Accordingly, I finished a twenty-five feet diameter balloon, coated with this new kind of varnish, which seemingly promised to answer a very good purpose, although on completion it showed a want of elasticity such as is necessary to overcome the effect of folding up the machine. She was named the "Experiment," and an unfortunate experiment she proved to be. When folded up and packed away for a few days, it acquired heat (affinity for oxygen) until it became a putrescent mass. From this I attempted to restore it by the application of drying oils, and under this as well as other ineffectual applications, I failed three successive times in getting it sufficiently inflated to carry out the object announced—a balloon ascension. These experiments were made in Lebanon and Dauphin counties, Pa., and served to make me pecuniarily bankrupt in the business, and almost so in reputation as an aëronaut. The third trial I let the balloon off by itself, determined to get rid of so unprofitable a machine.

I now returned to Philadelphia, and got employment at philosophical instrument making, which afforded me a pleasure, as well as a gradual acquirement of means with which to resume the balloon business again. While thus engaged a good opportunity was afforded me of studying and practicing in the science of electricity—a subject that mingles with the minutest details of all human operations. The profession of ballooning had given me an uncontrollable desire to study such subjects. These things in the mean time were preparing me better than I had been before to engage in my favorite avocation again, as soon as opportunity should offer.

While thus engaged, and during the latter part of the summer of 1837, the London newspapers brought us over an account of a most melancholy accident which had befallen Mr. Cocking, an aged and scientific gentleman of the city of London, while attempting a descent with a newly invented parachute. The old plan or form of the parachute being concave, or rather hemispherical, made it liable to violent oscillations while descending through the air, being considered very objectionable and unpleasant. Mr. Cocking proposed to construct one which should not be liable to such action, but should descend with a uniform and steady motion. This was to descend on the principle of cleaving or *wedging* through the air, instead of, as in the old plan, *compressing* the atmosphere. Its form was that of an inverted cone, or we might say funnel-shaped. The upper part, or large opening of it, was forty feet in diameter; the lower opening was four feet in diameter. It had hoops in the upper and lower openings to keep it distended. Around the lower hoop the cords were attached, to which the car or basket con-

taining the aëronaut was fastened. The lower orifice also served to let a column of air pass through which would act the part of a centre pole, rushing through it from bottom to top, and steadying it in its descent. The upper hoop was composed of two-inch tin tubing, the lower one of wood.

With this machine attached to Mr. Green's large balloon he ascended, in company with Mr. Green and another person, from the city of London, to an altitude of about 8000 feet. This parachute was fastened to the bottom of the car in which Mr. Green and his partner were stationed, and was so contrived that Mr. Cocking could detach it without the assistance of those in the balloon car.

According to the account given by Mr. Green, Mr. Cocking betrayed considerable excitement while descending. When at the altitude above mentioned, he requested Mr. Green to detach the parachute, but the veteran aëronaut, not having sufficient confidence in the structure of the new invention, refused to do so, and desired Mr. Cocking to do it himself if he was determined to try the experiment, of the successful result of which Mr. Green expressed some doubts. Upon this Mr. Cocking gave notice that he would detach himself, which he instantly did. The parachute did not fall far before the upper hoop *kinked* and finally broke, causing the parachute to collapse. The unfortunate experiment resulted in death. The balloon, when released from this weight, sped upward at a furious rate, the aëronauts with it betaking themselves to some air-bags carried along for the emergency, from which to inhale pure air while passing through the escaping hydrogen that was now being let off as fast as possible, to overcome the balloon's rapid ascending motion.

The account of this castastrophe was severely commented upon, both by the foreign and American newspapers, and universally condemned by them as a fool-hardy attempt, with no possible chance of success in its trial or practice. And although Mr. Cocking was represented as a man of no inconsiderable scientific attainments, still, he was denounced as being supremely visionary and unscientific in this particular instance.

Looking at this contrivance of Mr. Cocking's with an unprejudiced eye, it struck me as remarkably ingenious, embracing none but true principles adapted to the end for which it was intended; and so confirmed was I in this conclusion (and am yet) that I would not have hesitated to repeat the experiment with a similar machine, with no other alteration than a tough wooden hoop in the top of it instead of a tin one, as was in his machine. I ventured this opinion in a Philadelphia newspaper at the time, and promised to demonstrate its truth before the summer should pass by, by experiment with a true model of this new invention in letting down, from a great height, a living animal.

Having a short time before this received a letter from Mr. George Diehl, of Lebanon county, informing me that he had recovered the balloon "Experiment," which I had the summer before sent adrift as good for nothing, and which, he told me, was at my service if I wanted it, I at once determined to send for it and endeavor to repair and enlarge it, so that it might answer for a single ascension by being inflated with carburetted hydrogen gas, which was now being extensively manufactured by the Philadelphia city gas-works. Accordingly, this machine was procured; but it was in a very damaged and mellow condition; it had also lost much of its adhesiveness. With this I determined to make the experiment. To make it large enough to carry the required weight when filled with coal gas, it had to be enlarged so as to hold several thousand cubic feet more than was its present capacity. This was done by cutting it apart at its equator and inserting a belt, which was soon accomplished by merely pasting in the band by the adhesiveness of the old varnish, lapping the edges about one inch and pressing them together with a warm sad-iron. The belt was composed of black silk, varnished with bird-lime varnish, which was all very good; but the old part of the balloon was so mellow as to be scarcely able to bear its own weight when lifted up by any part of it. However, I knew that if it would bear the test of inflation it would have less force to bear when freed in the air with its burden. This is a mathematical principle in ballooning that very few people believe in, and are much less willing to test its truth.

Thus provided, an announcement was made to the Philadelphia public that a balloon ascension would be made from the corner of Filbert and Broad streets, with a balloon inflated with carburetted hydrogen, on Monday morning at 10 o'clock, September 18, 1837, in which I would show that Mr. Cocking's plan of a parachute embraced the true principle of safe and pleasant descent from great altitudes, which would on this occasion be shown, in comparison with the old-fashioned parachute, with which living animals should be let down from the height of a mile, and which should land on the earth in perfect safety.

Before giving my own description of this experiment, an extract from one of the newspapers of the day will be laid before the reader:

"The ascension of Mr. Wise of yesterday was truly an imposing and pleasing sight, and from the unbounded applause that greeted the intrepid aëronaut, both in and out of the enclosure, we should suppose that the gratification of Mr. Wise and his auditory was mutual. At about half-past eight o'clock the hum and bustle of the various pedestrians that were wending their way westward bespoke the citizens alive to the amusement of the morn; and at about half-past nine the streets, trees, fences and tops of houses in the vicinity of the arena were completely studded with men, women and children and naughty

boys. About ten o'clock Mr. Wise prepared to depart; the aërostat was harnessed to the car, and all the paraphernalia for the perilous voyage properly arranged. Poor Tabby and Tray were by no means disposed to become encaged without some show of resistance, and our canine friend especially seemed to dispute for his liberty with a growl; pussy, by her looks and gestures, seemed fully aware of the *cat*(astrophe) that awaited her feline dignity, but, *nolens volens*, was forced to submit. At length the cords were cut, and the pilgrim of the air gave us his adieu amid hearty cheers. The balloon ascended in nearly a perpendicular line with the yard, and then gently glided to the east; when he attained a height of about two thousand feet, poor Tray was *cur*tailed of *higher* honors, and was made to descend to a level with his fellow-animals of this lower sphere. He descended in the parachute of Mr. Wise's construction, which seemed to oscillate to and fro; he descended, however, we believe, in perfect plight. Now came poor Tabitha's turn, in imitation of the unfortunate Cocking; she, however, escaped his melancholy fate, and seemed to descend in a more *regular and steady position* than her canine companion. We believe the plan of Mr. Cocking to be more free from oscillation than the common one; both, however, we believe to be a presumptuous and hazardous experiment, without any beneficial results. We gazed upon the balloon until it was lost to our sight."

The above humorously-written account is a fair sketch of the actual occurrence. As regards the parachutes, which were both exhibited in the arena with their occupants, many comments were passed upon their respective capacities of resistance to the air in falling through it, and the Cocking parachute was almost universally condemned, a few scientific persons only agreeing that it would answer the purpose for which it was designed. And I would here remind the reader that, although public opinion is generally correct upon matters of common import, it is not always so upon matters peculiarly scientific. In this case the public mind seemed mainly influenced by the accident which had befallen the unfortunate inventor of the machine. Had the accident happened with the old-fashioned concave parachute, and the newly-invented one been now brought into competition with it, the latter no doubt would have received the most confidence, as regarded safety and utility. This dread of consequences and accidents sometimes influences the minds of scientific men upon new experiments, as was the case in my first announcement of exploding the balloon at great heights, letting the gas rush out instantly and depending upon the friction of the balloon through the atmosphere for a safe descent. The sequel, however, in both the cases just mentioned, proved that science was correct and public opinion wrong.

The day of the 18th of September was clear and calm, and well for me it was so, for the old machine was extremely mellow, and would not

have stood much of a blast. When the inflation had been nearly completed, a stone which had been thrown at one of the small pioneer balloons by a lad fell against the large balloon, and cut a hole of about seven inches length through it. This, with much difficulty, was repaired by pulling the machine to one side, so as to reach the spot from the top of a cask, and putting over the hole a piece of oiled silk coated with adhesive varnish. This accomplished, I started off, ascending perpendicularly to the height of over half a mile.

When but a few hundred yards east of this point, the concave parachute was dropped, which, in two seconds afterward, commenced to oscillate with great violence, to which motion the dog, its occupant, gave the most ample testimony by a yelp corresponding to each vibration as far as I could hear him. Seeing it safely in the hands of some individuals below, the Cocking parachute was next put to the test. I made particular preparations to watch its whole descent with a spy-glass. When it was dropped, it oscillated a little for a few moments, and then commenced describing spiral circles of perhaps a hundred feet diameter (this is a mere guess calculation however), the parachute all the while revolving on its own vertical axis, which motion was in the same direction as its spiral motion, and thus it continued gyrating with a double motion, but apparently very smoothly and gracefully, until it reached the top of a dwelling in Eleventh street, where it lodged safely.

Upon the release of these parachutes, the balloon commenced a rapid ascending motion, which, together with the expansion of its gas and the friction of the network, by some means displaced the patch from the rent the balloon had received while being inflated, which soon caused it to gravitate as fast as it had but a few moments before inclined to an opposite direction. Being at this time at a point over Green street near the Delaware, and the balloon going north-east, it was inevitable that it must descend in the river. Determined, if possible, to cross and reach the Jersey shore, I threw everything disposable—sand, ropes, grapples, newspapers, instruments, hat, coat, boots—overboard, in order to check the rapid descent of the balloon. But it was scarcely checked before it commenced sinking again, even more rapidly than before. Although it had reached a point near midway the Delaware, the undercurrent of the air drove it near the shore, and almost in contact with some shipping lying at Coates street wharf, from which it was immediately rescued by persons who had assembled to witness its descent. Thus ended an experiment which fully vindicated the *scientific* character of an individual who had been condemned for his temerity in an experiment that proved fatal to him, because of a mechanical defect in his machine (the upper hoop being tin, instead of *tough* wood). Even with this defect in the upper hoop, causing his parachute to collapse, he would have descended without serious consequences, by the friction of this vast surface through the atmosphere in a collapsed state, had he not lost his presence of mind.

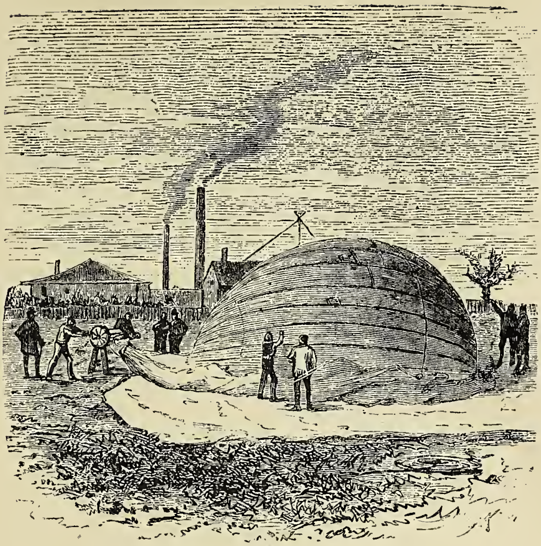
# CHAPTER VII.

Construction of a new balloon—First experiment with it—Had to be sewed—Incident showing how balloon could easily be filled with air—Second experiment with it—Made privately—Philosophical experiments by Professors J. K. Mitchell and Espy—Indian chiefs present—Keokuk's scrutiny of the affair—Black Hawk's remarks—Account of the voyage—Transparent appearance of the Delaware River when viewed from balloon—Encounter of whirlwind—Nearly descending in the fiery pines of Jersey—Final descent.

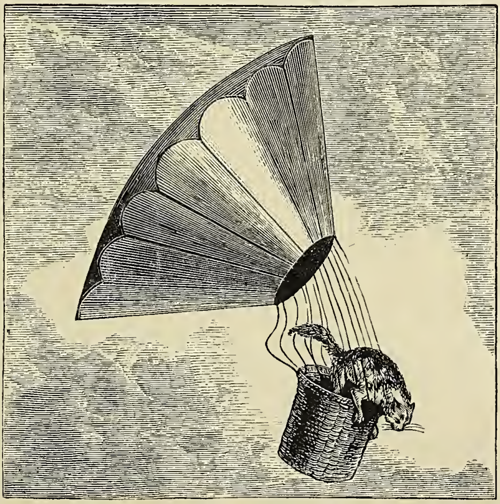
HAVING succeeded so well in the last experiment, and that, too, with a machine once before totally condemned, and now enlarged by the insertion of a belt, without a stitch of sewing in it, and the whole affair ending in the most satisfactory manner to the public, as well as with a replenishment of funds sufficient to enable me once more to engage in my favorite avocation, I now determined to build an entirely new balloon. The white India sarsenet was again used in the construction of this machine, and this time the varnish was made up of a composition of India rubber (caoutchouc), well boiled drying linseed oil and bird-lime. This varnish dried very well in the sun in about two days for each coating, of which the silk got three before it was cut in gores to shape the balloon with. This silk, thus prepared, when its edges were overlapped, and then pressed together with a hot iron, seemingly cemented in a very solid manner. As the belt in the balloon I had just used was cemented in this way, and answered the purpose so well, the whole new machine was cemented together by the same process. When it was completed and tested as to its impermeability to common air, it proved to be the most air-tight machine of any I had yet made.

With this I proposed an ascension from the same place where the former one had been made, also to take place in the forenoon, and the balloon to be inflated with carburetted hydrogen, or, as it is commonly called, coal gas.

The day turned out to be a cloudy one, with slight sprinkles of rain, and by the time the balloon was nearly filled, being about one hour before the time announced for the ascension, it was discovered to have an opening near its top of several inches in length, which, upon close



INFLATING A BALLOON WITH AIR.



POOR PUSSY!

examination, turned out to be an opening of one of the cemented seams. Seeing there was no time to be lost, and as it was impossible to make any successful repairs to it at the time, I concluded to make a short trip with it out of town, and at least save the credit of having made the ascension, brief as it might be. Accordingly, the car was hitched to it, and off I started, but with all I could do, throwing out all the ballast the first few squares of its flight, it attained but an inconsiderable height, for the opening in the seam increased upon its ascent, and the machine came down very suddenly in Chestnut street near Schuylkill Seventh street, dashing the car against the third story of a house, while the balloon swung over its top, bringing the cords of the rigging to an angle over the eave of the building, keeping the whole machine in that position for some time.

An immense crowd of people soon assembled around the place where the balloon was thus stationed, for it was only three squares from the place it first started. As a great tumult was going on below, and as I had not exactly accomplished what was designed in the announcement, I beckoned to the crowd below to be heard, which was immediately granted by a momentary silence, when I asked them what they wished me to do. To this I got a thousand or more replies, all tending to the same end, of saving myself and the balloon by all their various plans and suggestions. By this time a gentleman in the house came to the window and offered me his assistance. Upon this I fastened a rope to the car and threw the other end down to the crowd, requesting them to take charge of the balloon, while I would get into the third-story window of the house, which was accordingly done. When I got down, this immense crowd showed the most manly regard to me and my property; the balloon was towed back to the arena with care and order, where it was emptied of the gas and carefully folded and sent to my dwelling. These kindnesses made me feel more chagrined at the discomfiture of this experiment than if violent demonstrations had been exercised toward me for my non-fulfilment of the announcement, as was almost universally the case when my unfortunate predecessors in this vocation failed to keep their engagement.

I determined now that hereafter my experiments should be more in a way that would at least ensure a greater certainty of success in the most important part of the business—that of making a handsome ascension.

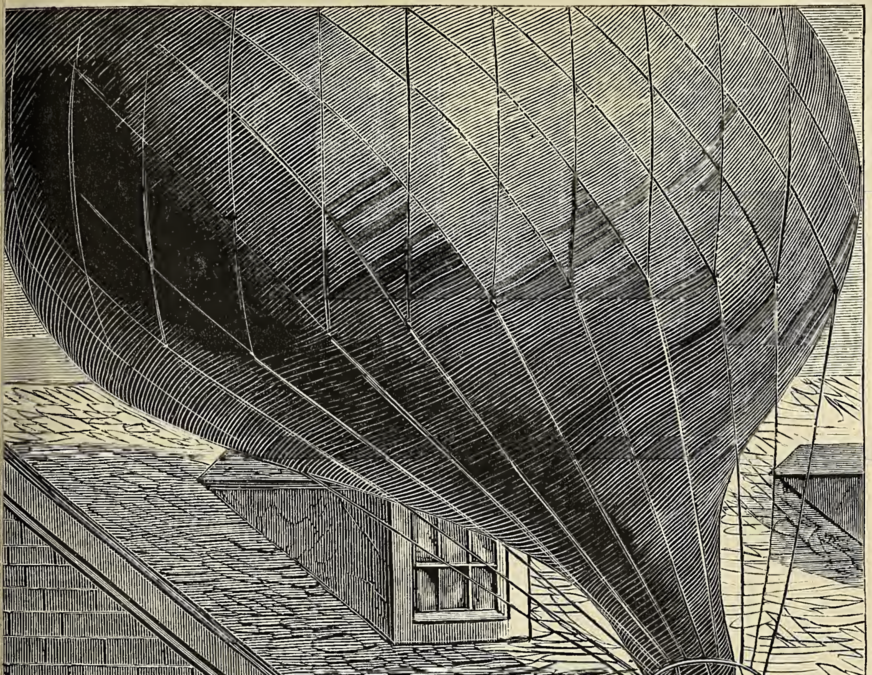
This balloon was immediately put under the needle, and a substantial seam put through each joining. While this part of the work was going on, an incident occurred, from the effect of the fan held by one of the ladies who were sewing at the balloon, which led to the discovery of a means of inflating these machines with common air that did away with the tedious and troublesome method heretofore practiced by American aëronauts—of filling with a large pair of bellows. It was simply this: By holding open the neck of the balloon and fanning into it with a

common feather or palm-leaf fan, the machine could be filled in less time than an hour, while the old method took a day, to say nothing of the trouble it took to rig up a smith's bellows.

Now, although the method of cementing the seams by merely pressing them with a hot iron did not answer the purpose in this case, it is not wholly to be condemned. There may be a cement made to answer for joining the seams without sewing them, though both these principles combined make the surest and best finish.

After this balloon had been overhauled, thoroughly repaired and considerably improved, she promised to do more service than any I had yet made. It happened that about this time several important Indian delegations were in Philadelphia, and it was proposed by Mr. John Cash and several other gentlemen of the city, particular friends to the progress of the art, that a private ascension be got up, and that these Indians, as also a company of "Florida Volunteers," be invited to attend the experiment. The whole expense was defrayed by the first-named persons, and I cheerfully volunteered my services and the balloon. Professor J. K. Mitchell also took an assisting and scientific interest in the experiment, and provided me with several air-bottles, made expressly for such purpose; and I was further provided with a "wet bulb" and common thermometer to make some experiments for Professor Espy.

In October, 1837, every arrangement being completed, the Indians, with the celebrated chiefs Black Hawk and Keokuk, the Prophet, and Black Hawk's son at their head, and the Florida soldiers, together with a numerous company of invited guests, being assembled for the occasion, at a few minutes after one o'clock preparations for a start were made. Just at this moment the chief Keokuk, with the characteristic sagacity of the red man, requested me, through his interpreter, to allow him to make an examination of the whole machinery and apparatus. To this I cheerfully assented, offering at the same time to give him such explanations as he desired. It was evident from the manner of his procedure that he had some doubts as to the fairness and reality of what was to be done, apparently thinking that it was a sort of a juggle to be played upon them by a "pale-faced *medicine-man.*" Everything in the car was observed and scrutinized by him with a keenness that would have done credit to a philosopher. (Indeed, I looked upon him as a great *natural* philosopher.) A large brass speaking-trumpet that lay in my car elicited from him particular inquiry. Having just before told him that I would sail above the clouds, he asked me whom I intended to talk to there with this instrument. I told him it was intended to talk down, not up. He also inquired the particular use of the grappling-iron and the philosophical instruments contained in the car; the use of the latter he could not satisfactorily comprehend. He next asked permission to make a test of the *upward* power of the balloon, which




"A GENTLEMAN CAME TO THE WINDOW AND OFFERED ME HIS ASSISTANCE."

was promptly granted him, several of the cords by which the machine was held down were brought together and placed in his hands. Upon these he gradually brought his weight, at the same time scrutinizing the others that were fast to weights, whereupon he nodded assent and belief in its powers, and at once acknowledged an abandonment of his skepticism upon the affair. Black Hawk, who until then had maintained a sullen silence and apparent unconcern of the whole affair, called me to him and informed me that this affair was very interesting to his companions, but that *he* had seen such things before. This was the truth; for some years before he witnessed, in company with General Jackson, who was then President of the United States, an ascension from the Battery in New York. The Prophet and young Black Hawk listened to and observed very attentively all that passed, but made no inquiries, being apparently satisfied with what they saw and heard.

This investigation being got through with, I shook hands as a farewell with the chiefs, and started off. At the moment of detaching the balloon, the Indians all simultaneously sprang on their feet and gave a wave of the hand, with a faint but shrill shriek, which I took as a parting salute, and responded to it in a similar manner as nearly as I could.

On this occasion the inflation was effected by the decomposition of water under the iron and vitriolic process. The voyage was a pleasant and interesting one, although some incidents occurred that were calculated to inspire apprehension; but these served in a measure to enhance the interest as well as to destroy the monotony of a mere aërial excursion. The atmosphere, being very clear, prevented the possibility of making the particular experiments desired by Professor Espy, they being based upon a cloudy atmosphere. One of the air-bottles provided by Professor J. K. Mitchell had to be parted with, in the emergency of one of the incidents above referred to.

I noticed, on this occasion, while crossing the Delaware River at the height of a mile, that the water appeared much more transparent, when viewed from that height, than when viewed from a boat or from its banks. And so remarkable was this phenomenon that, notwithstanding the constantly-muddled condition of that river in the vicinity of the place where it was crossed, I could trace the geological structure of its bottom for some distance above and below the point of crossing. After I had crossed the river, the balloon moving south of east, sufficient ballast was discharged to raise her 9000 feet high, when her course became due east, with a speed so moderate that it was only by the change of topographical scenery that I could discern its onward progress. The day was a remarkably pleasant one for the lateness of the season, and at this immense height the thermometer ranged at forty-two degrees. It must, however, be observed that the thermometer was not screened from the reflected heat of the sun by the balloon, which, I

afterward discovered, made a great difference in the indications of this instrument when carried aloft.

I enjoyed a range of vision from ninety to one hundred miles in diameter. Seeing that Philadelphia was now verging into the western horizon, and that Mount Holly and Vincenttown were passing beneath me in the same direction, and knowing that toward the east scarcely anything but forest and sea could now be expected, I commenced a rapid descent at half-past three o'clock, some distance to the east of Vincenttown. The first obstacle which obstructed me in this design was the contact of a whirlwind, which enveloped the whole machine in a cloud of dust, sand and dry vegetable matter. This so tossed about the aërial ship that I was obliged to take refuge in the bottom of the car, the better to maintain my centre of gravity. After being thus swung about for a minute or two, and carried up south-eastward for a considerable distance, the whirlwind dispersed and the balloon began to descend again. Having before this seen clouds of smoke ascending from the pines to the south-east of me, which I then took for collieries, I now found it to be the pines on fire, and the balloon fast descending right into them. Knowing the consequences of such a catastrophe, from sad experience, the ballast yet remaining in the car was quickly disposed of. Finding this not to check the balloon sufficiently from falling into the fiery desert below, the speaking-trumpet and air-bottles had to follow, which fortunately enabled me to cross the conflagration. The balloon now rose again to the elevation of three thousand feet, and rapidly traversed the pines toward Barnegat Bay, and for a moment I thought of continuing the voyage to the beach; but when the heaving ocean showed itself in the eastern horizon, swelling its bosom, as it were, up into the blue-vaulted heaven, it looked to me like too much risk for the advantage likely to be gained by a landing on the beach sand. Consequently, I determined to make a descent in the pines, which was accomplished at half-past four o'clock. The descent was made with considerable force, but the trees were so close to each other that the balloon did not slide down through them until she was half discharged of her gas. Having before the descent kept an eye to the necessity of finding my way out of the pines, I rolled up the balloon, stowed it in the car, and then struck to the north for a road I had observed, which was soon reached; and meeting some huntsmen, they assisted me in conveying my machinery to Burr's saw-mill, which is thirty-eight miles from Camden, and about forty from where I started.

# CHAPTER VIII.

Experiment at Easton, Pa.—Failure and its consequences—Ascent from the public square at Easton—End of cause of failures—Decomposition of balloon—Prospects of future operations—Simplicity of the art—Success of pupils.

ALTHOUGH this last-constructed machine seemed to be a very good one, and answered the purpose of an ascension admirably in its last trial, still, it was defective in a part that only develops itself after the lapse of time (affinity for oxygen), and doomed me to the chagrin of one more failure, and the last, happily, that I had the mortification to endure, except in one case where the voyage was incomplete, though not essentially a failure of ascent.

In the spring of 1838, I went to Easton, Pa., to gratify the citizens of that beautiful town with a "balloon ascension." The balloon, having now lain over winter, had become harsh and fragile—a property that gum elastic varnish is subject to when rendered dry by metallic dryers; it also under increase of temperature being extremely liable to spontaneous combustion. This caused me to fail in getting the balloon sufficiently inflated the first time I tried it in Easton; and although thousands of people from all parts of the surrounding country had assembled to witness the sight, no evil consequences except my extreme mortification ensued from the disappointment.

To make a brief account of this part of the affair, and to show the character of the Eastonians under such circumstances, I will here make one extract from an Easton newspaper, alluding to the occasion, to wit:

"*Wise's Balloon Ascension.*—On Tuesday evening last a meeting of the friends of Mr. Wise was held in the court-house, when it was decided that the ascension should take place on Saturday the 26th of May, inst., between the hours of eleven and one o'clock on said day (from the centre square). The same collecting committee for the different blocks will take up a collection on the day of the ascension. Their names are: Joseph Barnet, L. A. Buckley, Edward J. Seip, Thomas Sletor, John Finley, H. Hamman, John A. Shouse, John A. Innes, H. S. Heckman, Doctor J. P. B. Sloan, W. Green, Geo. W. Barnet."

Such was the result upon the failure at Easton. Though an entire

stranger in the place, the first intimation from the people to me upon the unfortunate experiment I had just attempted was that I should try it again at the expense of the citizens, which request was cheerfully complied with, and the ascension accomplished to their utmost satisfaction and to the handsome remuneration of myself.

Of this voyage I published an account in the Easton newspapers. It was a magnificent and interesting one; but as the details embrace no peculiarities or phenomena but what have occurred in those already given, the newspaper notice of the occasion will suffice:

"On Saturday last, 26th of May, 1838, according to advertisement, Mr. Wise made his promised balloon ascension from this borough. The arrangements for inflating the balloon were simple but effectual, and shortly after 11 o'clock A. M. all was ready for a ride in the clouds. At about fifteen minutes before 12 o'clock Mr. Wise placed himself in his car and cutting the cord which restrained the aërial vessel, at once rose majestically into the heavens. Many thousands were spectators, and we believe that every one acknowledged the perfect beauty and sublimity of the ascension. Mr. W. repeatedly waved his flag and hat in return to the cheerings of his friends below, until at length his buoyant vehicle penetrated a dense cloud at some two thousand feet elevation. Here he was lost sight of by the spectators; and although occasional glimpses were had of the voyager at different places, nothing definite as to his whereabouts was known until the arrival of the Morristown stage with the aëronaut, balloon, etc., at about 10 o'clock P. M."

This voyage was ended at the foot of Schooley's Mountain, a distance of about twenty miles from Easton eastward, in one hour and a half from the time of starting. The thermometer stood at 74° at the moment of ascension, and fell as low as 36° during the flight of the balloon. Two ascensions had now been made with the machine. Before its last trial it had to be recoated with a purely linseed oil preparation, in order to make it pliable and impervious to the gas. Upon this it answered the purpose very well; but as the weather grew warmer, the balloon being packed up, it manifested its attraction for heat, and when, in the early part of July following, I returned to Easton to make preparations for another ascension, the people having determined for one in the following August, I found the balloon in a state of decomposition. It had been packed up in a box, which upon being opened did not develop that characteristic inclination of ignition, as had been observed by me in oiled silks before. This time it had commenced going into ashes by forming holes in various parts of its central mass, and it was not until the box had been opened, the balloon unfolded with its decomposed parts exposed, and then folded up again and left in that way for several hours, that it gave symptoms of ignition. And these symptoms were so intense that the whole mass was thrown into a trough of water to prevent its inflammation.

With the destruction of this machine by spontaneous combustion also ended the mode of preparation which caused it, and which heretofore had been the most perplexing and obstructive hindrance to my progress in practical ballooning. During the past winter I had instituted various experiments upon elastic varnishes, and in the end discovered that linseed oil alone contained the elements necessary to a pliant, fast-drying and non-adhesive varnish, and was not only free from the property of acquiring heat or oxygen spontaneously, but possessed the other property of being a non-conductor of these elements.

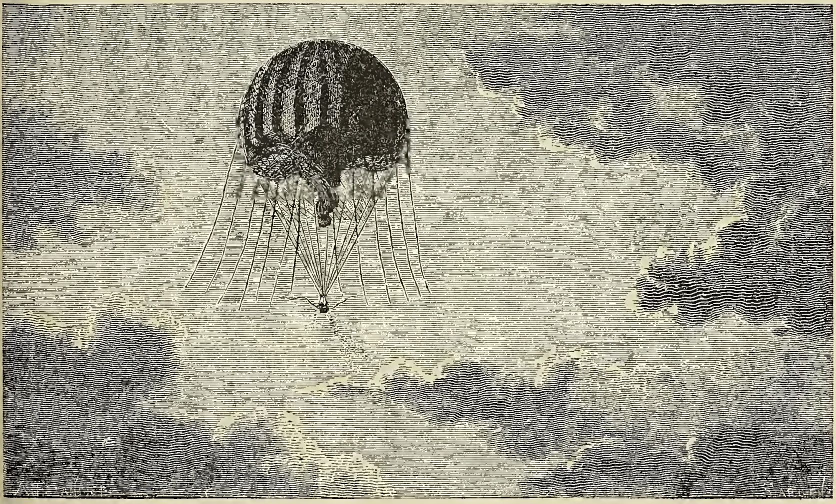
After this discovery my career as a practical aëronaut became easier and more successful. This had the good tendency of establishing in the common public mind that ballooning was governed by principles as comprehensive and systematic as were those of sailing a boat or running a steam-engine; and the dissemination of these principles it is now my object to bring to the understanding of every mind that is capable of conceiving the single rule of three in arithmetic, so that we shall soon see the atmosphere as full of balloons as are the rivers and bays now of pleasure yachts. "But its danger!" exclaim a hundred voices. "But my hundreds of ascensions under disadvantageous circumstances!" is the reply. And if that is not satisfactory, then I say that dozens of persons have already taken my balloons with no other knowledge than the simple instructions given them on a sheet of paper, and have made balloon ascensions as successfully as myself. Some of these have since constructed their own balloons.

## CHAPTER IX.

Construction of cambric muslin balloon—New principle involved in it—Second ascent from Easton—Thunder-storm—Parachutes—Explosion of balloon above the clouds—Descent with it collapsed—Letter from an unknown friend about it —Ascent from Allentown, Pa.

JULY having already numbered a third of its days, my second ascension from Easton advertised to come off on the 11th day of August following, my balloon totally ruined and unfit for use, placed me in a predicament which required all my energy and knowledge in the business in order to make the affair terminate in a satisfactory manner. The people of Easton and its neighborhood having treated me so generously before, I was determined, if possible, not to forfeit a continuance of such treatment by any delinquency of mine thereafter—not even by a postponement of the time of the contemplated ascension. Consequently, the construction of a cambric muslin balloon was determined on, as in this material facilities were afforded that did not exist in silk. The muslin, being much wider, required less sewing. Its preparation with varnish could also be effected quicker than that of silk, as it could be soaked in varnish for the first coating, and would require but one more coat, put on with the brush, while silk required three coats at least, and all put on with the brush. Under these auspices the new balloon was commenced; and as it was to be coated with the newly-invented varnish, it was also determined that it should become the test of a new principle of descent. Having, however, always met with so much opposition to every new proposition in aëronautics that I suggested, I determined to keep the new idea to myself until it should have passed the ordeal of actual experiment. This idea was the explosion of balloons at great heights, depending upon their friction through, and resistance of, the atmosphere for a safe descent. The idea of such an experiment—bursting one's balloon a mile or two above the earth and permitting, inevitably, the gas to rush out of it instantly—may startle the reader, even the student of the science; nevertheless, it was made, repeated, and can be made again, with a certainty as great and principles as comprehensive as that a pocket-handkerchief will not fall as rapidly to the ground when thrown out of a third-story window as will a brick.

"I APPROACHED A DENSE MASS OF THUNDER-CLOUDS."



"THE BALLOON EXPLODED."

The cambric muslin machine was completed in due time, being of a globular shape, twenty-four feet in diameter, and differing from all former ones made by me only in not having a double top for several yards across, immediately around the valve. This precaution in the construction of balloons arises from the greater strain falling upon that part of the machine in consequence of the network being slightly fastened to it at that point to keep it in its proper place while the balloon is inflating, as also the valve being inserted there, which must undergo some stress in working it. Although I had not announced that I would attempt the explosion of the balloon when up in the atmosphere with it, nor had I positively determined to make the experiment on that occasion, everything necessary to such an experiment was observed in the construction of this machine.

The fixtures necessary to this are simply contrived in the following manner: The top of the balloon is of the single material, muslin or silk, as the case may be, and at three different points round the valve are small holes the size of a five-cent piece; through these holes strong twine cords are passed, coming down over the outside of the balloon four or five feet, where they are firmly sewed to corresponding seams. In the inside of the balloon they are brought together in one common joining, from which proceeds a single cord down through the neck of the machine into the aëronaut's car, where it can be used for the purpose of its design. Where these cords pass through the envelope of the balloon around the valve, suitable pieces of oiled silk are cemented over the holes, to make it air-tight.

Thus prepared, and the 11th of August, the day for the ascension, being at hand, nothing remained but to go on with the experiment. The day was fine in the morning, but at noon the heavens indicated an approaching thunder-storm, which by ten minutes before two o'clock passed over, with no other injury than the wetting of the network of the balloon and the dispersal of a portion of the audience, who for a brief space of time were driven to places of shelter.

At a few minutes before two o'clock the balloon was detached from terra firma. I had with me two parachutes containing animals, one a cat, the other a dog; and as the balloon approached a dense body of black thunder-clouds, some vivid flashes of lightning, accompanied by violent peals of thunder, greeted my upward passage. This gave the first part of my voyage a terrific but grand and imposing appearance. It seemed to me as though heaven's artillery was celebrating the occasion as one of progress in the new-born science, and it inspired me with a determination to try the experiment of atmospheric resistance as a means of safe descent in the event of explosion of the balloon at great heights. As soon as an altitude of 2000 feet was attained, the conical parachute (this was one on Cocking's plan), with its occupant, was detached, which landed in safety near Lafayette College, at the head of

the town. Soon after this the balloon attained an altitude of about 4000 feet, at which point the oiled silk parachute, with its occupant, was detached. This was to foreshadow the effect of the experiment of exploding the balloon, and was so contrived as to have an apparent disadvantage compared with that of the large machine. This small one was nothing more than a balloon in a collapsed state. When thrown overboard, it fell some distance before it expanded completely, and after it had expanded it fell with a very irregular vibratory motion, which was not the case with the other one. Upon this I concluded, however, that the experiment would not be hazardous, if not disagreeable. I was also assured from my experience that a balloon in a flaccid state, or only partly so, would invert—that is, the lower part cave into the upper part and assume a hemispherical shape—in a rapid descent.

When an altitude of about 13,000 feet was attained, the balloon became fearfully expanded—to its utmost tension; and having but an inch-diameter tube in the neck, the gas began to issue through this orifice with considerable noise. I would here observe, however, that any slight sound occurring in so perfectly quiet a place as is that of a balloon a mile or two above the earth makes apparently a great noise. At this period of the voyage it was evident that unless gas was speedily let off the balloon must burst from expansion, for she was still rising, and the explosive cord, being tied rather short, had also become tense, and must evidently be tending toward a rupture at the points it passed through the balloon.

At this critical moment I became somewhat excited; and as I looked over the side of my car, I observed the sparkling coruscations of lightning springing from cloud to cloud a mile beneath me as the thunderstorm was passing its last remnants below. The storm was moving from S. W. to N. E. and the balloon was sailing from N. W. to S. E., passing New Village and Asbury, and I now could see the earth in that direction. I took out my watch, noted on my log-book the time—twenty minutes past two—and as I was about returning it to my pocket, thinking at the time whether it were not best to relieve the explosive rope, discharge ballast and abandon for the present the idea of this experiment, *the balloon exploded!* Although my confidence in the success of the contrivance never for a moment forsook me, I must admit that it was a moment of awful suspense. The gas rushed from the rupture in the top of the balloon with a tempestuous noise, and in less than ten seconds not a particle of hydrogen remained in it. The descent at first was rapid, and accompanied with a fearfully moaning noise, caused by the air rushing through the network and the gas escaping above. In another moment I felt a slight shock. Looking up to see what caused it, I discovered that the balloon was canting over, being nicely doubled in, the lower half into the upper; it had fallen, condensing the column of air upon which it was falling, until it had arrived at a point

where it was so dense that the force of the whole weight pressing down on it was arrested, which caused the parachute to tilt over. The weight of the car, however, countervailed the tilting tendency, giving it an oscillating motion, which it retained until it reached the earth. The velocities of these zigzag descents were marked by corresponding notes of the wind as it whistled through the rigging of the balloon. On reaching the point where the lower current of air traversed the upper, another and more violent shock than the first took place. From this point the oscillations became more severe, each one causing in me a sensation similar to that persons experience when dreaming that they fall.

The wind from the S. W. drifted the machine several miles in its direction before it fell to the earth. As I neared terra firma, all the ballast was thrown overboard; but when I struck, it was with a violent concussion, for the machine was just then at its maximum velocity of descent. The car struck the earth obliquely, and I was thrown about ten feet forward from it. The balloon had fallen alongside of me, and so complete was the collapse where the lower part had doubled into the upper that it was with difficulty separated again. The car had turned bottom upward, and there I stood, congratulating myself on the result of this exciting experiment, the perspiration rolling down my forehead in profusion, for the atmosphere below felt oppressive. The landing was made on the farm of Mr. Elijah Warne, about ten miles from Easton. Before many minutes had elapsed after this descent, I resolved to repeat the experiment in Philadelphia at the first opportunity.

On my return to Easton, the day after the ascension, I received the following letter:

"New Village, August 11, 1838.

"Mr. Wise, Master of the Aërial:

"I hereby certify that my first sight of your air-ship was north of Henry Snyder's; it then apparently passed not far from William Kinney's, then directly between the inhabitants of New Village and the sun; we saw the gas rushing from the balloon like the steam from a boiler; it created between us and the sun the colors of a rainbow, and it was some time before we got a second sight, when you appeared to be lowering. As the size of the balloon became larger, we could discover a black spot underneath, about twenty feet. I pursued on foot until I saw you alight near Thomas Thatcher's.

"From your most affectionate, but not acquainted, friend,

"WILLIAM SHARPS.

"N. B. And others."

From this it appears that spectators on earth could not see the balloon at the time it was falling during the collapse. Its descent for the first few seconds must have been faster than at any other period

of its fall, and during that time it affected me more too, for the sensation caused a dimness of sight, and I closed my eyes momentarily from the effect.

On the 8th of September following I made an ascension from Allentown, Pa. I had resolved, after this one was accomplished, to go to Philadelphia, and repeat the experiment of exploding the balloon at a great height in the air. The Allentown ascension was a very complete one. The following extract from the journal always kept during my ascensions embraces the most interesting features connected with that trip:

"The balloon was now perfectly stationary over the outskirt of the town. I next concluded on starting a fresh interest in the spectators below. Having all the ballast bags filled with dust, several of them were emptied overboard, which for a moment enveloped the balloon in an artificial cloud, which presented a very interesting phenomenon to the lookers-on. This sent the balloon up about two thousand feet more, approaching at the same time a solitary cloud. As I passed the angle of reflection of this cloud, a very sensible heat was felt, showing clouds to be good reflectors of heat, as they are of light. When the balloon got in proximity to the cloud, it became somewhat agitated, making rotations one way, then another; at the same time the cloud apparently receded from the balloon, as by repulsion. Here several more bags of dust were discharged, which clung much more to the balloon than did the former; even the heavier particles were now attracted to the surface of it, and remained there some moments. When the machine had risen considerably above this point, the dust fell from it in a cloud. This was a very interesting part of the voyage, and convinced me that the science of electricity and meteorology would be much improved by the aid of balloons."

## CHAPTER X.

Consultation upon exploding balloon again—Announcement to do so in Philadelphia—Newspaper comments on it—Explosive contrivance—Balloon bursted from top to bottom—Its descent and motion—Place of descent—Explosion of balloon while aloft not fatal to the aëronaut—Atmospheric resistance not fully appreciated by theorists.

HAVING arrived in Philadelphia in the month of September immediately following my experiments at Easton and Allentown, I consulted several scientific gentlemen upon my intention to announce that I would make an ascension and explode the balloon when over a mile high. Although they did not seem to doubt the philosophy of atmospheric resistance, nor the theory of converting the balloon into a parachute, still, they most earnestly endeavored to dissuade me from my intention, as they considered it a risk of life. Could they have persuaded me with half the philosophy against it that I had contemplated for it, it would never have been attempted by me.

Feeling convinced that all was right, an announcement was made that such an experiment would be made on the 1st of October, 1838, from the corner of Seventh and Callowhill streets. The day was a remarkably fine one, and the balloon moved in five different directions during her flight. The editorial notices of five principal newspapers of Philadelphia will be first given before I shall give my own account of it.

1st. "Mr. Wise ascended yesterday afternoon at half-past four o'clock with his balloon. The sky was perfectly clear, and the balloon passed slowly to the north-west; in about twenty minutes the rich blue of the heavens was marked with a thin, filmy white, which was the gas escaping from the top of the balloon. At five o'clock, and for half an hour, we watched, at a distance from the city, the balloon, far to the west, which resembled some large planet pouring out a flood of light. This was caused by the rays of the sun. The reflection was exceedingly brilliant, and the whole balloon seemed a ball of fire, while the hoop in the centre looked like a dark belt.* This was one of the most beautiful sights we have ever seen of the kind."

2d. "Mr. Wise yesterday afternoon, as per notice, made an ascension

* It had no hoop in the centre.

in his parachute balloon in the handsomest possible style. There was scarcely a breath of air stirring, and he rose almost perpendicularly to a great height, and was out of view at the writing of this paragraph, having been up about an hour. He went up without any difficulty; how he gets down we'll tell to-morrow."

3d. "Mr. Wise, the aëronaut, made a successful ascension on Monday. The balloon passed over the Schuylkill, and Mr. Wise eventually descended, according to his promise, by letting off the gas gradually at an extreme height; by means of a cord and pulley he converted the balloon into a parachute, and thus came down. It was a most fearful undertaking, and was anticipated by competent scientific authority as calculated to carry with it destruction of life."

4th. "Mr. Wise made yesterday afternoon one of the most beautiful ascensions that Philadelphia has ever witnessed. About half-past four he left 'old mother Earth,' and like an arrow from a well-strung bow reached the welkin, cheered in his upward flight by the shouts of the dense mass which filled the neighboring streets. At six o'clock he was yet in sight, there being no breeze, and apparently in the *statu quo* of ten minutes after his departure. The explosion which was to make of his aërial vessel a parachute did not take place, owing, we suppose, to the fact that he could not get beyond the precincts of dangerous obstructions to such a daring attempt. At one time the appearance of the balloon was beautiful; the gas issuing from it seemed like smoke, and the sun shining upon the lower part of the balloon, which was considerably depressed and exhibited a tremulous motion, gave it the appearance of being on fire. We did not learn where he descended."

5th. "Mr. Wise's ascension yesterday afternoon from the enclosure corner of Seventh and Callowhill streets was one of the most beautiful we ever saw. We did not witness the process of inflation, as at the time of our entering the enclosure, half-past four o'clock, the pipes communicating the gas to the balloon had been withdrawn, and the aëronaut, having entered the car, was arranging his cords and other fixtures. This was speedily accomplished, and at twenty-two minutes before five o'clock the cord which confined the voyager to the earth was cut by Mr. Wise; and bidding the assembled thousands 'good-bye,' he soared aloft almost perpendicularly, although bearing a little south for some twenty minutes, after which, at a height of some several thousand feet, a different current of air wafted him to the north, until he was brought to a position almost perpendicular to the place of starting. At this altitude he encountered another current of air, by which he was rapidly carried in a west-by-north direction for several minutes, when a small cloud of gas was suddenly discovered to have issued from the balloon, and soon after another of about the same quantity, after which the object of attention seemed gradually to descend for a short time, until it had arrived at an atmosphere of sufficient density to ex-

actly weigh it. It now pursued the even tenor of its way in a direct course, W. N. W., until nearly out of sight from the enclosure, when at about half-past five o'clock the balloon seemed suddenly converted into a parachute, and commenced a rapid descent. We watched its descent with a spyglass until so low that the buildings hid it from our view—say at an angle of some ten or twelve degrees from the horizon. We know not at what distance from the starting-point the descent was made, but should judge it to have been several miles. We hope, at least, that the intrepid voyager reached the earth in safety, though we had some fears, from the apparent rapidity of his descent."

Such were the notices of some of the public journals of the day. They all but one agree as to the conversion of the balloon into a parachute; that one saw it at the time it was forming into such a shape, and perceived the depression in its lower part. In this last arrangement I had a pulley fixed into the valve disk, on the inside of the balloon, through which a cord passed, whose one end was fastened to the lower part of the balloon, by which that part might be drawn up into the upper as the gas rushed from the top. I. found this portion of the contrivance utterly useless. When the balloon was exploded, the lower part did not immediately invert, as in the former experiment of this nature, for on this occasion it burst open from top to bottom and caved in sideways. I was at the first discovery of this somewhat alarmed, fearing that it might come down with a continuous accelerated velocity, from which anxiety I was, however, soon relieved. It caught the wind like the mainsail of a ship and *slid* down upon the atmosphere in a spiral course, with a uniform velocity. The descent was made a mile or two on the west side of the Schuylkill, and not less than several hundred persons had followed from the city, and were on the ground where and when it was made. The concussion was not nearly so violent as the rapidity of the descent would seem to have warranted, and was not harder than that which would follow the jumping from an elevation of ten feet to the ground.

As the machine was descending, the lower part, one-third the length of the whole balloon, hung loosely in the network, swinging to and fro, and occasionally pressed upward slightly by the current of the air. The resistance of the machine against the atmosphere acted on the principle of the inclined plane, sliding obliquely down over it, describing spiral circles until it struck the earth.

Since this experiment, balloons have exploded for aëronauts while aloft, and in no instance have their persons been seriously injured, but every newspaper and periodical account of them sets the escapes down as miraculous. And the miracle is always in the height from which the machine falls to the earth, the resistance that the atmosphere must present to it never hardly being taken into account. We might as well call the descent of the flying squirrel from the high forest tree to the

earth without sustaining any bodily injury a miracle, for its surface, compared to its weight, is not in a greater ratio than is the weight of a man compared to the surface of a common-sized balloon, whatever shape the latter *can* assume.

This is a principle in aëronautics which has never yet been duly considered, although a very ingenious mathematical deduction upon the descent of parachutes has been given in this work. Meteorological and astronomical deductions are yet much to be facilitated by the science and practice of aëronautics. There are things in its philosophy that men have not yet dreamed of. There are sublimities in its practice that the world has not yet been fully prepared to realize.

Although the principle of atmospheric resistance is a self-evident thing, and its application to a safe descent from great heights has been demonstrated, there are yet very few persons who are willing to believe it so well established as to entitle it to be practiced with impunity.

# CHAPTER XI.

Second ascent from Allentown, Pa.—Electrical phenomenon—Descent and collapse of balloon—Third ascent from Allentown—Neglect at starting—Descent of small parachute—Predicament from neglect—Thunder-gust—Phenomenon attending it—Reflections in a critical case—Paradoxical descent—Appearance of the gas when released at great heights—Peril overcome—"Misfortunes never come single-handed"—Descent and its consternation—Danger of being shot—Up again—Final descent—Next experiment—Novel ascent—An amateur—His opinion of aërial voyages—Its healthfulness.

IN the spring of 1839 I was invited to make another ascension from Allentown, Pa., which was readily accepted. The ascension was made on the 27th of April, at about two o'clock in the afternoon, and the following extracts from the log-book of the trip will be found interesting: At twenty-five minutes past two o'clock my vessel stood over the town of Bethlehem, and had also reached the clouds, the course changing from E. to S. S. E., the thermometer standing at 36°. This temperature felt unpleasantly cold; my ears began to ache violently, accompanied by a crackling, noisy sensation; my nose began to bleed, and I felt very much distressed for a few minutes. The balloon became rapidly distended and highly electrified, and an open sack of sand lying in the car showed strong electrical effects by a portion of it being drawn up against the balloon, from which it would drop down again, keeping up this motion for over a minute. When the balloon left the earth, the gas in it was of a milky color, but now, when it had risen to a height where the machine had become fully distended by diminution of atmospheric pressure, so that I could look in through the neck of it, the gas had become perfectly transparent. While this change of color in the gas was going on it gave out water, which dropped freely from the lower orifice of the balloon, and it also emitted a strong sulphurous odor. Some powerful electrical effect must have produced these phenomena, and I always found strong electrical effects when passing from one current of air into another.

On this occasion the wind was very strong when I descended, which was forty-two miles from Allentown; and having the explosive apparatus in the balloon, and failing in the first landing to get a hold with

the grappling-iron, I found it very convenient to explode the machine the second time it touched the earth.

On my return to Allentown the citizens of that place expressed a desire to have a third ascension. This was made on the last Saturday of May, 1839, and as it was attended by circumstances for a while placing my life in jeopardy, as well as bringing into use a mode of causing the balloon to descend which would seem paradoxical, an account of it will be here given. At the time it happened no particular account of the circumstances alluded to was given in the papers relating the voyage, for the reason that I was fearful it might *increase* the belief that ballooning was extremely dangerous.

At half-past 2 o'clock in the afternoon, everything being in readiness to detach the balloon from the inflating apparatus and prepare for the ascent, and just at the time this was all accomplished, and nothing more remained to be done but to draw the valve-cord out of the neck of the balloon, where it generally remains during the inflation, a gentleman from the South was introduced to me, who commenced a conversation which drew my attention from the preparation of the valve-rope; and while conversing with him, I being in the car at the time, the balloon was let up the length of the restraining rope, where, after a few minutes of adjustment of things in the car, I bade him and all others a good-bye and cut off the rope. The last fibre of the cord which held me to the earth had scarcely been severed before the thought flashed on my mind that the valve-rope had not been secured. But it was too late now to remedy the mistake; the balloon was mounting rapidly. For a moment I began to despond, and I would have given everything possessed by me in the world to be down on the earth but one minute; it was an intensely painful moment, but I rallied my spirits quickly, took off my hat and swung it around, which was vociferously responded to from below.

I had with me a parachute containing an animal; and knowing that the disposal of this would send me higher from the earth, I at first felt an inclination not to part with it; but upon reflection of its being announced to be done, and the people of course waiting for its descent, it was at once thrown overboard. I watched its progress until it reached the earth, when it was picked up by some men; and oh how I wished myself there too! However, having over a hundred miles between me and the Atlantic Ocean, I felt hopes that something might be done in the interval that would enable me to get down. My first observation in view of this was to ascertain the velocity of the balloon in her eastward course. This was found to be about fifty miles per hour, and convinced me that the Atlantic was likely to be reached before the ascending power would give out so as to let me down. I could not persuade myself that the balloon was in a bad enough condition to meet such a hope, for it had just undergone a thorough repair, and was in good condition—a quality, in this instance, not very desirable. While thus

meditating upon the best means of effecting a descent, I found that already a great portion of Jersey had been traversed, as Princeton was not far ahead of me. The current of wind below, just in the cloud region, was moving from the south-west, and the one in which the balloon was sailing was from the north-west. To the north the atmosphere was clear, to the south it was charged with clouds. The lower current was carrying in it a thunder-gust, which presented a beautiful phenomenon. As I was over a mile above it, and four or five miles off, it gave me an opportunity to scrutinize its operations sidewise and above. The storm and the balloon were also moving toward the same point, so that I was continually nearing it, but so high above it that no danger was to be apprehended from its effects. The rain was pouring down from it, and made a noise like a mill-dam. The clouds were rolling over and against each other, the lightning flashing in zigzag flashes through them as long as their side view was open to my sight. Presently it was all overcast below me, the thunder rattling like small arms, without any of the rolling reverberations that are heard below. The most splendid part of this scene appeared just where the storm was passing some dense clouds that were moving in the upper current, and had recently made their appearance. Several times the surface of the lower stratum swelled up suddenly like a boiling caldron, and this swelling was immediately followed by the most brilliant ebullition of sparkling coruscations. Twice it swelled up, or rather shot up, like an immense pyramid, quickly followed by an evolution of promiscuous flashes, and then quickly disappeared again, as though it had dissolved. It was a magnificent sight; but in recurring to my critical situation, its charms passed from my mind with its departure to the north of me.

As soon as the storm had passed off, which was in about fifteen minutes, the sky became clear to the south and east. Princeton was some distance to the north of me, and I was moving nearly due east. Less than an hour would now take me on to the Atlantic; it was already in sight to the north-east and the east. The balloon, seemingly, had not yet lost any of her altitude of the last hour. I had plenty of ballast to go up, but no control of the valve to get down. It was an embarrassing moment. First I looked at my stock of provisions, which consisted of about half a pound of water-crackers and as much cheese, together with a bottle of porter, which was handed me by a friend at the time of starting. This seemed all well enough to hold out with, even to cross the ocean, for at the rate I had been moving less than three days would take me across. But the balloon, good as she was, could not be reasonably expected to hold out, although between forty and fifty pounds of ballast were to be depended on. The neck of the balloon, as is usual in common aërial voyages, was left open, and the natural affinity of gases for atmosphere must in less than three days so deteriorate the hydrogen in it as to bring it down. This hope now

fled. What was to be done? A thousand things were running through my brain—even that of jumping overboard when on the confines of land and plunging in the ocean. Faint hope! it were worse than sticking to the ship.

The proud and boundless Atlantic was now distinctly seen swelling its mighty crest to the arched roof of heaven in the east, dashing its angry foam into the face of the clouds. This aroused all my energy, all my fertility of mind. I had been endeavoring to split my little flag-staff, in order to splice it and tie a pen-knife to the end of it, with which to cut the balloon, but it would not answer. My next effort was to burst the balloon by violent jerking of the car—the explosive rope was not in the machine now; but this also failed, and only went to show how immensely strong a network and balloon really were. Now a new idea flashed on my mind—*I can get down by going up;* and in another moment one bag of sand after the other went overboard, until half the ballast was gone. The balloon was mounting rapidly—the visible horizon was fast contracting; the yawning Atlantic was thus shut out of view. The atmosphere grew extremely cold at the height I had now attained, but the excitement of the occasion kept me warm enough. The balloon was now completely distended; the gas was copiously discharging itself at the neck, which, having no tube in it, was now open in a circle of eighteen inches diameter. As the gas mingled with the outer air, it had the appearance of a white cloud. By violent jerks in the car impulsive volumes were discharged from the neck, the balloon still rising. In ten minutes after I had commenced this the balloon had attained her maximum height, and immediately after began to sink rapidly. The valve-rope in the meantime partly rolled out of the neck, so that I could reach it with the flag-staff; my peril was at an end, and I felt as happy as Archimedes when he cried out *Eureka!* and I really *did* cry out "Victory! victory!" as the threatening Atlantic came into view by the rapid descent. The immense discharge of the gas, and the rapid admixture of atmosphere and hydrogen within the balloon, consequent upon the free connection by the large opening of the neck and a rapid descent, brought the machine down to the earth fast enough without the use of the valve-rope, which had now been brought within my reach.

The length of this voyage, as made by the course of the balloon, was about a hundred miles, and occupied two hours and a half, it being five o'clock when I landed. After this a number of ascensions were made by me in various parts of Pennsylvania; but as many of them in their accounts would embrace only a repetition of what has been said, such only as will afford new peculiarities and instruction to the student will be related.

While getting ready for a second ascent from the village of Kutz-

town, in Berks county, Pa., in the summer of 1839, it began to rain very hard, and continued to do so the remainder of the day. A young man who had attended as a spectator expressed a great desire to accompany me on the voyage; and as the weather turned out to be very unpleasant, I offered to let him occupy my place, which he accepted. As the newspaper account gives the substantial particulars of the voyage, it may be properly quoted:

"A Novel Ascension.—Mr. Wise was to have made a balloon ascension at Kutztown on Saturday, the 20th inst., and was to have been accompanied on his voyage by Mr. Wellington Dunlap, a young man of Berks county. In consequence of the rain that afternoon, the balloon and net had become so wet and heavy that it would not carry two persons, and at the earnest solicitation of Mr. Dunlap, Mr. Wise consented to Mr. D.'s making the voyage alone, and gave him the necessary instructions for the management of the balloon. He ascended through a heavy shower of rain, as was estimated, about a mile, and after remaining in the air about thirty-five minutes descended within three miles of the place whence he started, highly delighted with his voyage and the result of his experiment. Mr. Dunlap is under the impression that his trip was a greater benefit to his health than all the medicine he has taken for ten years past. The novelty of the voyage, the pure air which he breathed, and the freedom with which all the circulating fluids of the system are allowed to act in so rare an atmosphere, all combine to produce a salutary effect. There is some philosophy in his idea; and if we were sure (as we often heard Mr. Wise say was the case) of there being no danger in the experiment, we should be half inclined to recommend it."

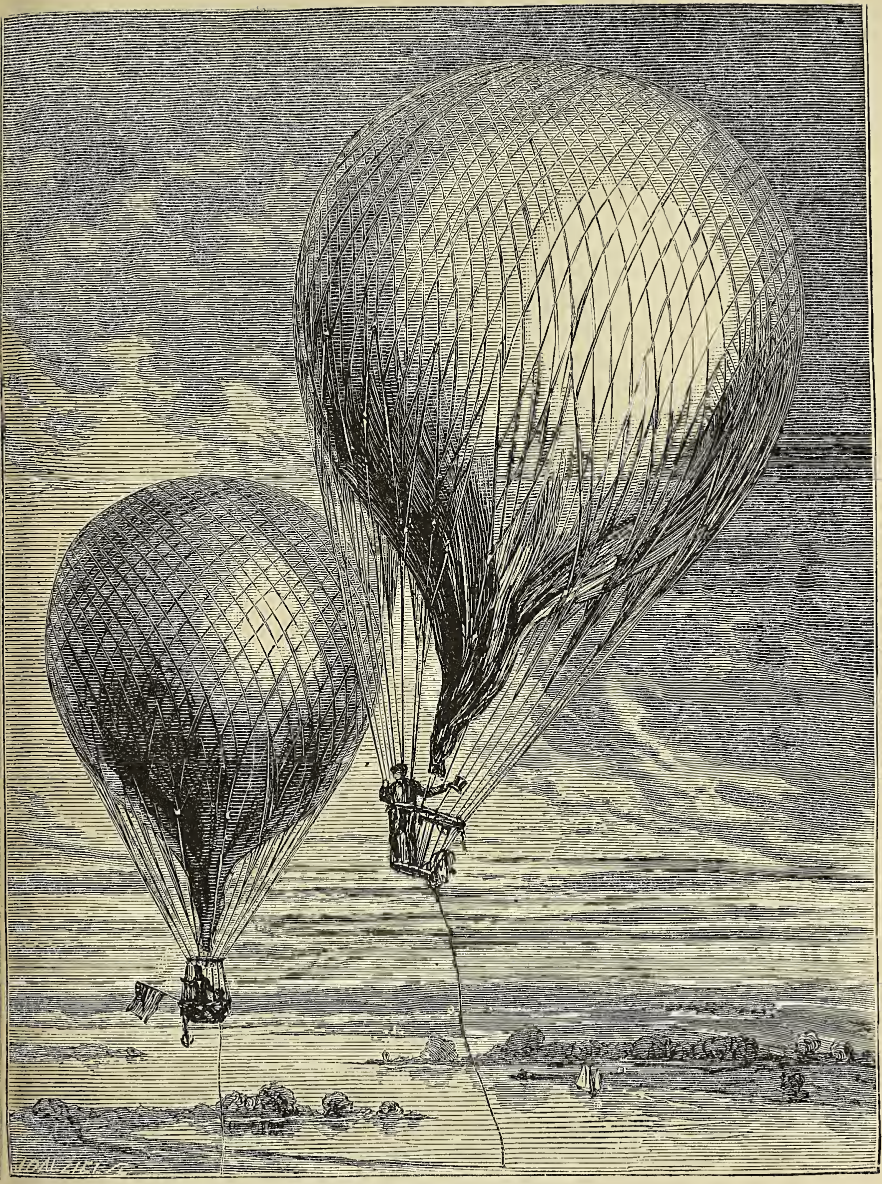
Now, this young man had never witnessed an ascension before this; and had I not been confident that there was no particular danger in the experiment, he should never have gone up by my consent. The only risk that I incurred was the loss of the balloon by his getting disconcerted in the descent, of which he was cautioned before he started.

## CHAPTER XII.

Double balloon ascents from Philadelphia—Conversation while aloft—Singular air current—Subject for meteorologists—Electricity and air currents—Descents of the rivals.

ON the Fourth of July, 1840, it was announced that Mr. Paullin and myself would ascend, each in his own balloon, but in company with each other, from the Pennsylvania Farmer's Hotel yard, in Philadelphia. The ascensions were to be made at meridian, and the balloons were to be inflated with carburetted hydrogen gas, procured from the Northern Liberty Gas Company's pipes. I had now abandoned the cambric muslin balloon which had served me well for a dozen ascensions, and was then sold to an amateur aëronaut, and had a silk one prepared, with the newly-discovered varnish. It was of a size sufficiently large to carry a passenger and ballast when filled with pure hydrogen, being twenty-three feet in diameter, but too small in capacity to carry a passenger and ballast in the car when inflated with the carburetted hydrogen. This latter gas could raise up only forty pounds, where the pure hydrogen could raise up sixty pounds, so that it was one-third less in power. By dispensing with the car and substituting for it a light board, to which the cords of the network were fastened, it would be relieved of some weight. In order to make this gas answer the purpose for the occasion, this had to be done, or the balloon would have to be enlarged; and as the former seemed the least trouble, I determined to make the ascension without a car. Mr. Paullin's balloon was large enough to carry him with a car and all its rigging.

Everything being ready and the balloon filled at half-past twelve o'clock, I proposed to Mr. Paullin that we should start and detach from the earth at the same time. Accordingly, the signal for the start was given, upon which I cut loose and ascended five or six hundred feet before Mr. Paullin's balloon followed. It seems he was apprehensive of the balloons coming in contact if started at the same moment—an event which I had anticipated also, but had no fears of its consequences, on account of the elasticity of such bodies as balloons. When about a mile above the earth, Mr. Paullin's balloon approached so near to mine, being about fifty feet below and twenty or thirty feet to the west of me,



A RACE IN THE CLOUDS.

that we could easily converse with each other. At the start I was standing on the board which served me for a car, but now I was sitting on it, with my feet hanging down. Mr. Paullin hailed me, and said he was afraid his balloon would strike against my feet if he should suffer it to rise higher. It had been announced in the advertisement of the occasion that the aëronauts would contest which should "stand *highest* in the estimation of the public." Mr. Paullin was of course desirous to mount above me, and his balloon being larger than mine, gave him some advantage in that respect. I told him he should not get above me if I could get hold of his balloon, as I was determined to hold it down. It had now got very near my feet, and I was ready to seize it with one hand—the other was required to steady myself with—when it apparently glanced to one side and rose up by mine thirty or forty feet off. As Paullin passed, he cried out, "Wise, it looks dangerous to see you sitting on that board." I replied, "Never mind the danger; I'll be after you presently." His balloon now stood about two hundred feet from mine and a little above me. He said, "What do you think of the sight?" I replied, "It is a magnificent one; do you see the Liliputians on the Delaware?" Paullin said, "I feel a breeze coming." His balloon now went up several hundred feet above the height of mine; and as I was intently watching its motion, I observed it suddenly agitated—so much that Paullin lowered himself in his car, for he had been standing up until then. His balloon shrugged up in the network, as though it had been drawn up under the net, and in another moment it shot off southward, immediately over the Delaware, at the velocity of a mile a minute, for a distance of five or six miles down the river. This phenomenon was the more remarkable, because my balloon was not in the least affected by it, though not three hundred feet from Paullin's. It could not have been a general layer or current just above the place occupied by my machine, as I threw off some ballast, and my vessel rose up at least two thousand feet higher without being affected by it.

This circumstance showed that a rapid current of atmosphere existed which was neither *wide* nor *deep*, as my machine was not far off in a horizontal direction, and crossed the path of Paullin's balloon at a right angle, but a few hundred feet above it, without falling into the rapid current. There is an inseparable connection between electrical and atmospherical currents. All my experience in passing through these currents has developed this fact.

While I remained almost stationary over the city for half an hour after Paullin's balloon had drifted off, I perceived that he made several efforts to land, but as often struck the surface of the river, until, by going up to a considerable height, he was drifted some distance over the river into Jersey, where he effected a dry landing some distance below Woodbury. Half an hour afterward I descended near Red Bank, half the distance from the place of Paullin's departure.

## CHAPTER XIII.

Ascension from Lancaster, Pa.—Effect of rough workmanship in balloon machinery—Breaking of valve-spring—Sudden descent—Ascension from Chambersburg, Pa.—Scenery—Singular appearance of South Mountain—Descent—Its magic effect on a cripple—Second ascent from Chambersburg—Rainy day—Sombre appearance of the earth—Passage through the rain-clouds—Grand spectacle above the clouds—Harbor in the distance—Illusion—Second stratum of clouds—A heavenly mansion between the two—Its sublimity.

ON the 5th of August, 1840, I made an ascension from the county prison yard, in the city of Lancaster. It was a remarkably fine day for an aërial voyage, and a very trifling defect in part of the machinery made it a very brief one, much to my disappointment. As regards the satisfaction of the spectators on this occasion, the following extract from one of the Lancaster newspapers may be considered as a fair exposition:

"Everything was in complete order and ready at the time fixed for his departure. He went up in splendid style to an immense height, the balloon moving rapidly upward in a westerly direction. When about a mile and a half high, the parachutes, each containing a cat, were detached, and both landed safely, the balloon continuing to ascend.

"At this period of his flight, the aërial vessel floating toward the east, Mr. Wise began to make preparations for a descent, intending to come down within speaking distance of the earth, and then to resume his onward course. The valve at the top of his balloon was opened to permit the gas to escape, and could not be shut again, *the spring having broken.* His descent was for this reason extremely rapid, but he landed in safety near Dillersville, a mile or more from the starting-point, having been, we should judge, about twenty minutes in the air. There was still in the balloon a sufficient quantity of gas to have re-ascended, could the valve have been closed, but this was not in the power of the aëronaut, as the valve is on the inside of the balloon; and under these circumstances it was inexpedient to attempt the further prosecution of the voyage.

"We have heard but one opinion expressed in relation to this ascension. All concur in saying it was the most gratifying exhibition of the kind which has yet been witnessed by the citizens of Lancaster."

Here, then, an aërial voyage was abridged to the distance of a mile or two in length, and a space of time less than twenty minutes, for which the most ample arrangements had been made to have it of long duration and interest in the way of coming down, holding up a few moments for refreshments, then going up again, making it interesting along the way, as well as at the points of departure and final termination.

Now, the practice of this art is a fine one—indeed, it may be very properly termed one of the "Fine Arts;" and though its science is not intricate, the mechanical workmanship connected with its practice requires skill, mathematical exactness and the highest degree of finish, in order to prosecute it with success. The valve in my balloon requiring some repairs before the occasion just referred to, and thinking that a watchmaker would coil and finish me a wire spring much neater than I could do it myself, I preferred on this occasion to have one made by such a mechanic. Accordingly, one was made and inserted in the valve; but the mechanic who made it, not observing the precaution of applying a wooden clamp or piece of leather around the wire when screwing it in his vice, thus bruised and weakened it, from which damage the valve-spring broke when worked in the cold region of the atmosphere.

When this happened, the balloon was a mile and a half high, and the force of the air against its lower surface, caused by a rapid descent, made the gas escape with considerable violence from the aperture at the top. Persons who witnessed it from an oblique position remarked that it threw out a "stream of vapor embellished with the colors of the rainbow." The balloon came down with a rolling, surging motion, and my descent, when near the earth, would have been as hard as when the descents were made by parachute, had not a large quantity of ballast been thrown out when within a few hundred feet of the earth, which checked its velocity to a moderate degree.

During the latter part of the same month I made an ascension from Chambersburg, Pa., of which the most interesting incidents, as related in the journal kept at the time, will be here given:

"Here the balloon shifted from a northerly to an easterly direction, the atmosphere becoming extremely cold. At this time the scene presented a sublime appearance. Around and beneath me the clouds rolled in majestic grandeur, occasionally rising into peaked summits, like volcanoes, and then dissolving down again into the mass below. The valley beneath, where it could be seen, presented the most gorgeous landscape scenery that I ever beheld. After rising about a mile and a half above the clouds, a most magnificent prospect of the country on either side of the mountains that enclose the Cumberland valley presented itself to my view. Looking over the North Mountain, the eye was greeted by a succession of valleys rising up and out of the earth,

as it were by magic, to the view, as the balloon rose higher, beautifully variegating the scene. The valleys had a lively color, and appeared like circular pea-green bands laid down between dark-green plats of verdure—

"Like olive bound with laurels fast
Whose verdure must for ever last."

"Looking over the South Mountain, the scene was entirely different. Here an extensive landscape was presented, circumscribed by rugged and massive clouds, interspersed with numerous roads which looked like so many white lines tortuously spread over its surface, and one which meandered from the base of the mountain upward, until its further extremity was apparently lost in the clouds above which formed the horizon of my view, giving to it a magic appearance. This mountain had a very different aspect from the others which were in view. Its dark foliage, interspersed with innumerable whitish-looking tortuous lines, being roads and paths, gave it a very unique but beautiful appearance. All this time I continued ascending by a gradual discharge of ballast, until the clouds had sunk so apparently low as to hover immediately over the surface of the earth. The cold had now become intense, and yet the rays of the sun, coming in contact with my person, caused a piercing sensation like that from needle points on those parts where it shone. I also suffered a violent pain in the ears and joints of the jaws, followed by a slight dimness of sight."

At ten minutes before four o'clock I descended on the farm of Joshua Kanagy. This old gentleman was so crippled with rheumatism that he was obliged to walk on crutches, and on these he hobbled toward the place of descent, where the balloon was fastened to an apple tree by the grappling-iron, chafing and surging under a brisk breeze that was blowing at the time; the old gentleman seeing this, and also observing me at the same time in the car, and thinking that his assistance was necessary in the emergency, became more excited every jump he made with his crutches, until at length he became so impatient from his slow progress, that he dashed his crutches aside and ran the balance of the distance between him and the balloon with as much nimbleness as a hale young man.

When I returned to Chambersburg, which was on the evening of the day the ascension was made, having landed only about twelve miles off, the citizens had already determined to induce me to a repetition of the experiment, being so highly pleased with the one I had just made for them. This came off a few weeks afterward, the day appointed for it bringing with it rain, which gave an entire new feature to the voyage.

At twenty minutes after three o'clock the balloon was freed from her moorings and described a semicircle in her upward course, making a half tour round the town. The borough had a very sombre appear-

ance, caused by the dark shadow which covered the earth. Objects, however, were more distinctly visible than in clear weather; and this is always the case when looking down upon the earth from a balloon; where the sun shines on the earth there is more of a quivering haze covering it than where it is in shadow. The scene below had a melancholy aspect; all nature seemed to be in a state of mourning.

Before I passed the limits of the borough, a parachute containing an animal was dropped, which descended fast and steady, and just as it reached the earth my aërial ship entered a dense black body of clouds. Ten minutes were consumed in penetrating this dismal ocean of rainy vapor, occasionally meeting with great chasms, ravines and defiles of different shades of light and darkness. When I emerged from this ocean of clouds, a new and wonderfully magnificent scene greeted my eyes. A faint sunshine shed its warmth and lustre over the surface of this vast cloud sea. The balloon rose more rapidly after it got above it. Viewing it from an elevation above the surface, I discovered it to present the same shape as the earth beneath, developing mountains and valleys corresponding to those on the earth's surface. The profile of the cloud surface was more depressed than that on the earth, and in the distance of the cloud valley a magnificent sight presented itself. Pyramids and castles, rocks and reefs, icebergs and ships, towers and domes—everything belonging to the grand and magnificent—could be seen in this distant harbor. The half-obscured sun, shedding his mellow light upon it, gave it a rich and dazzling lustre. They were really "castles in the air," formed of the clouds. Casting my eyes upward, I was astonished in beholding another cloud stratum far above the lower one; it was what is commonly termed a "mackerel sky," the sun faintly shining through it. The balloon seemed to be stationary; the clouds above and below appeared to be quiescent; the air castles in the distance stood to their places; silence reigned supreme; it was solemnly sublime; solitary and alone in a mansion of the skies, my very soul swelled with emotion; I had no companion to pour out my feelings to. Great God! what a scene of grandeur! Such were my thoughts—a reverence for the works of nature—an admiration indescribable. The solemn grandeur, the very stillness that surrounded me, seemed to make a sound of praise.

This was a scene such that I never beheld one before or after exactly like it. Two perfect layers of clouds, one not a mile above the earth, the other about a mile higher, and between the two, a clear atmosphere, in the midst of which the balloon stood quietly in space. It was indeed a strange sight—a meteorological fact which we cannot possibly seek to make ourselves acquainted with without soaring above the surface of the earth. Why is it that the cloud surface corresponded to the earth's surface? What causes two distinct cloud strata, one a mile above the other, in the sky at the same time? The elevated towers or projections

that appeared in the distance on the surface of the lower stratum are common to the cumulus cloud, and on this occasion were beautified by the peculiar light cast through the upper stratum. But the distinct regions or vaults of clouds, and the lower one presenting in its upper surface the same irregularities as the earth, are questions for science yet to explain.

I remained in this magnificent heavenly mansion for an hour, and during that time did not move two miles in a horizontal direction, as it was perfectly calm and serene. The day was of a murky character, warm and rainy, and at the time the balloon entered the cloud region it was raining slightly; otherwise it had no peculiar characteristic. The lower stratum of clouds I judged to have been from two to three thousand feet in thickness, as it took seven minutes in passing through. During the descent, and while in the cloud ocean, the sound of my voice produced a very distinct echo.

I made a final descent about five miles from Chambersburg, at thirty-five minutes past four o'clock.

## CHAPTER XIV.

The atmosphere—The phenomena of inter-aërial conditions—The cloud wilderness—Mirage—Aureola—Thistle seed in the upper air current—Over a thunder-storm.

THE transparent shell that surrounds our world, and which is termed the atmosphere of the earth, seems to be an order of Providence pertaining to all individualized forms of nature. The molecules of matter as seen under the microscope floating in their menstruum, and which can all be contained in a space no larger than the eye of a cambric needle, represent in a very minute way a species of phenomena such as we behold in the great ethereal vault over our heads: they have atmospheres. In the one case, we behold the motion of atomic matter in the smallest possible condition of functional movement; in the other, we behold it in the largest possible condition of movement susceptible to the human scope of vision. All these bodies are surrounded by an elastic medium—an outer envelope, it may be termed. Beyond these two extremes of magnitude all is mystery, deep and dark, entirely beyond the reach of a rational conception as to distance and material. Without this stupendous unknowable majesty of nature, and taking only that portion of the universe that is perceptible to us in greater or less degree, we may still exclaim, in the words of the Psalmist: "When I consider thy heavens, the work of thy fingers, the moon and the stars which thou hast ordained: what is man, that thou art mindful of him? and the son of man, that thou visitest him?"

Our atmospheric shell, occupying a space between heaven and earth, is full of unexplored philosophy. It is the great laboratory of earthly life that gives us being, and enables us to move with ease and grace of motion, although we carry a load of it on our persons of fifteen pounds to every square inch of our bodies, which on an adult individual is an aggregate of about twenty-five thousand pounds. Remove this load from the body of a man as much as it is possible by placing him in an air-tight chamber and then applying the air-pump, and he will swell up like a toad drawing itself full of wind. Send an old wrinkled man up in a balloon three to four miles high, and he will become smoothed out like a plump-faced youth. Even his old flattened eyeballs become more

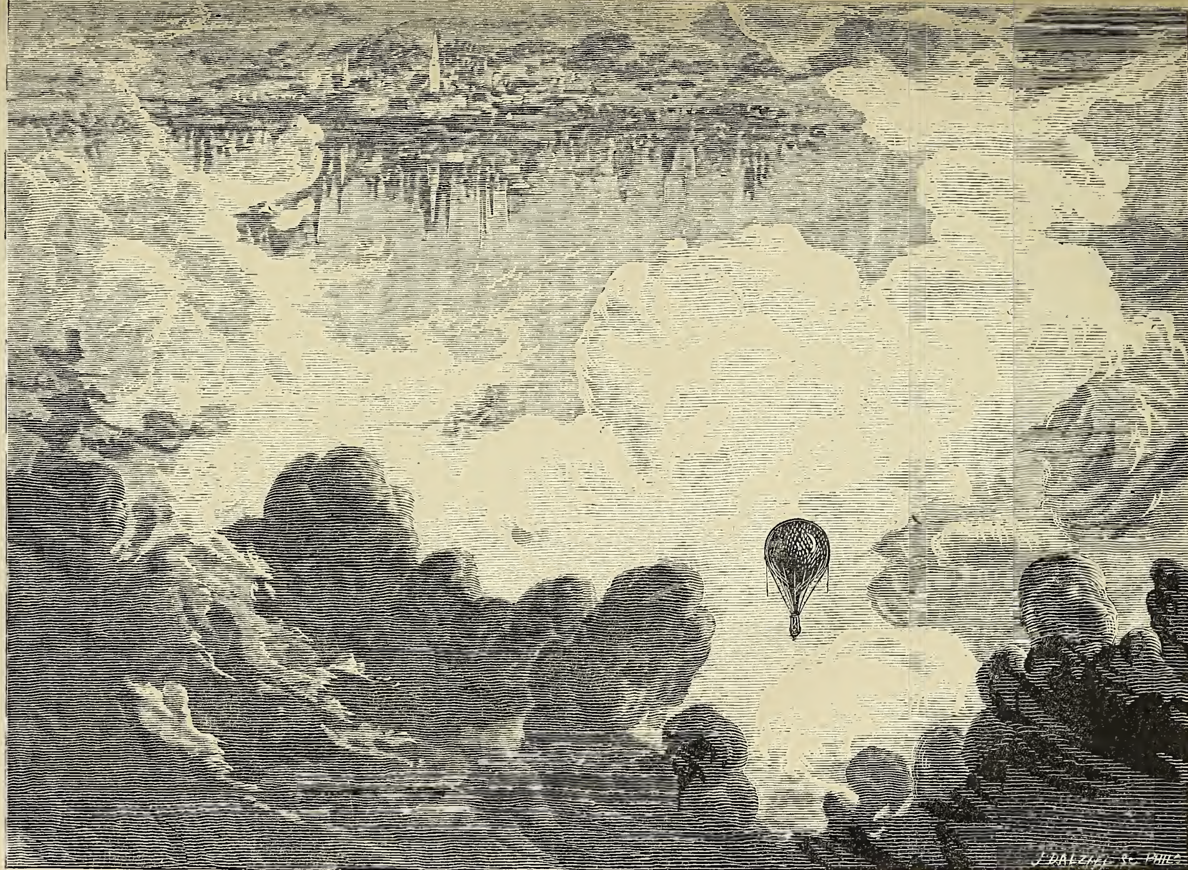
rotund, and this enables him to see better up there than down here below.

The writer of this can read fine print without spectacles, when high up in the air, such as is blurred and illegible to his unaided eyes on the level of the earth. Not only does he see better up there, but he feels better, breathes a purer air, inhales larger volumes with every inspiration. His blood courses more rapidly through his system, and his mind becomes more exalted, as it ponders over the grandeur of the scenery while floating in the ethereal world. It would be a good place for invalids suffering from torpid action of the internal organs. It would make them exult over the new life born of the inspiration of an increased vital action. Then they would also throw off effete matter—more morbid secretion than it is possible to do in any health-giving localities on the surface of the earth. This is not conjecture or romance, but the matter-of-fact experience of the writer over and over again, and it will be admitted by the rational mind that has never experienced it.

"Ah!" says the inexperienced, "but how about the danger, the fear that must overtake one when suspended between heaven and earth, hanging as it were by cobwebs? It makes one shudder to look up at a person so situated." That is very true, but the shuddering is all to those below, while those above are entirely freed from it as soon as the connecting cord is cut. As they sail upward, a delight bordering on ecstasy takes the place of fear; and this may be claimed as one of the strongest arguments that the air, as well as the water, is intended by a kind and generous Providence to come under the dominion of man. It will become the stepping-stone to a higher civilization, and the Society for the Advancement of Social Science should not ignore it in their deliberations.

The varied phenomena of inter-aërial conditions are not yet primarily explored. This ocean of life and light, covering the whole surface of the globe, accessible to a depth of five or six miles without let or hindrance, subject to all the variations that heat and cold can impart to matter, and giving us a means of transition from one part of the world to another, from the Orient to the Occident, and from Afric's sunny heat to polar icy cold, is worthy of a higher order of experience than mere spectacular sight-seeing in acrobatic performances. When we look up at the blue vault of heaven, it seems to bend down over us on all sides until the cerulean tapestry rests in prismatic fringes on the horizon. When we rise up in the midst of this vault to an altitude of three to four miles and look down, we behold a reversed phenomenon; the earth looks like a bowl with its circumferential margin looming up in the horizon to join the lower edge of the upper bowl, and thus we find ourselves all the time in the centre of the visible universe as it were. Such is the appearance of things during a clear atmosphere.

When the air is full of clouds, the scene is very different indeed;




MIRAGE.

then you are in a wilderness; and when the cloud region is in a stormy condition—rainy, or having a tendency to rain—you are like the mariner in mid-ocean in cloudy weather without a compass; and so far as knowing your whereabouts is concerned, you may be considered lost in the desert. Your compass does no more good than a jack-o'-lantern to direct you, because in that condition of the atmosphere the needle dances upon every point of its circle in obedience to every change the cloud matter undergoes in its condensation of water, or of being absorbed again in the invisible ether around it. And this renders the knowledge of your course enigmatical, though you may yet get an occasional peep of the earth below through the chasms and defiles of these mountains in the air. In this condition, however, you are not in danger of the hard knocks of the mariner when subjected to rocks and reefs upon his leeside, because the aërial boulders receive you in their elastic embraces as softly as if you were sliding into a bed of eider down.

You can easily soar up above this moist and dusky complacency; and when you emerge from it, you will be greeted with a sight far more picturesque and beautiful than was ever imagined. The upper surface of the lower cloud stratum, while it is slightly overshadowed by a higher stratum of "mackerel" cloud some thousands of feet above, presents a varied appearance. You can see mountains and valleys, precipices and projections, lakes and rivers, domes and spires, and all the time the scene is changing. Sometimes beams of light are perceived issuing from above and illuminating these aërial castles with all the richest tints of refrangible drapery, and then again melting away into a mellow mist of dissolving vapor. Sometimes the peak of a mountain may be seen jutting up through this lower stratum, just after the action of a thunder-storm, and then the foliage of its trees, with their trunks partly buried in the thick mist, renders the scene still more picturesque and wonderful, because the first seeing of the spectacle is not immediately to be realized as solid matter, after looking so long upon vapor-formed objects.

This is all very grand, and of itself a great inducement to cloud travelling; but there is another phenomenon often to be seen in the atmospheric world that has more attraction still. Mirage, as witnessed from balloon heights, is far more grand and imposing than as seen from the earth or water. And there are two kinds of this phenomenon for the air traveller—the one caused by the different density of air-patches when the atmosphere is changing its condition of moisture, the other, inherent to the balloon itself, caused by the lightly refracting medium with which it is filled—some form of hydrogen gas. In the atmospheric refraction you see at times the earth below delineated in the atmosphere above. A city or village on the earth becomes a city or village in the upper air, sometimes doubled; one erect, the other upside down. I

have seen the town of Lancaster, Ohio, thus depicted, and as distinctly defined to the eye as the real town possibly could be. It was marvellous to watch the church spires of this counter-built town point to point, as it stood in the heavens a mile or more above the earth. The course of a river thus thrown upon the ethereal screen is truly beautiful. It lasts about as long as the duration of a rainbow.

The other kind of refraction, caused by the balloon itself, as thrown upon the cloud-screen below you, is also fraught with interest and beauty. The halo of colors—the aureola, as it is termed—with the shadow of the balloon in its centre, is all the time changing its shape, in accordance with the angle of the cloud-surface beneath. Sometimes it is elongated, at others it is circular; and while it shows itself as brilliantly as the most intensely-colored rainbow upon the cloud surface, it becomes at times visible upon the surface of the earth, as the balloon goes sailing over green fields in a clear atmosphere when the air is in an incipient condition of change as to its moisture.

Like the sea, composed of a system of rivers traversing its great body throughout its length, breadth and depth, the atmosphere is filled with a system of tides and currents as regular and periodic as the blood in its courses through the venous and arterial system of the human body. The ancients were well acquainted with this order of nature, or they could not have stated it so tersely as it stands written in the first chapter of Ecclesiastes, sixth and seventh verses: "The wind goeth toward the south, and turneth about into the north: it whirleth about continually; and the wind returneth again according to his circuits. All the rivers run into the sea; yet the sea is not full: unto the place from whence the rivers come, thither they return again."

These air currents slide over and by each other in a marvellous manner, playing, as it were, all the functional parts of a great nervous system of the world. They are productive of electrical phenomena, as you pass from one to the other. When during such transition card-paper, or any other light substance, is thrown from the car of the aëronaut, it is instantly drawn up against the body of the balloon, hangs there for a few moments with a tremulous motion, and is then repelled and obeys the law of gravitation. At such times the gas-filled globe seems to play the part of a planet toward itself, drawing matter which remains there until its attraction is neutralized by the greater power of that of the earth. On several occasions the same ballast that was emptied gradually from its sack over the side of the car recurved into an upward stream against the body of the balloon, where it hung for a while and then dropped off toward the earth.

In the latter part of summer, when sailing high above the lower cloud stratum, it is not an unusual sight to see myriads of thistle-seeds floating in these aërial streams. These seeds are all provided with tiny balloons of fine silk-like fibres that float them on the air as cobwebs do

the spiders. Of all the animal tribes without wings, the spiders are the most favored. They can mount a tall sprig, or an elevated stake of a fence, and from thence launch out upon their aërial craft, to find a lodgment on a like projection at the opposite side of a lane or street. One often meets these spider bridges in going through a lane in the early mornings of the summer. These webs may be seen detached sometimes from any earthly substance, floating high in the air, with young spiders hanging in them like sailors in the rigging of a ship. The pollen of plants in little nebulous patches also travels in these aërial streams. When caught in a thunder-shower, it is washed down upon the earth and on the roofs of houses, and from thence into rain-water casks, and being of a yellow color, is by many persons taken for flowers of sulphur. An examination with the microscope always reveals its character.

A very beautiful scene in cloudland is spread out to one aloft when sailing directly above a thunder-cloud. The watery mass is brilliantly illuminated by the sunlight—indeed, its brilliant whiteness, as dazzling as snow, is painful to the eyes. And then it heaves and rolls about like the boisterous ocean. Ever and anon the vapor is suddenly projected upward above the general cloud level like a great volcanic cone, followed by a discharge of electricity, dancing across it like diamonds upon a snow-bank. This as suddenly melts it down again, and then follows a dash of rain that sends back to the ear a sound resembling a cataract. The report of these electrical discharges, as heard above the cloud, is not of that deep, sonorous, rumbling sound, but of a snarling crash like the report of a rifle. These storm-clouds when in active operation present on their upper side the appearance of a great bubbling, boiling caldron of snow, not at all dreadful and dark, as seen from below by the observer on the earth, but of so soft and downy an aspect as seemingly to invite a plunge into their midst.

The atmosphere is truly a great laboratory of nature, wherein the distillation of ether, fire and water goes constantly on in some part of it or another, preparing the elements of life and nutrition for animated nature in the lowermost part of its depths. At no time can we see the providence of nature manifest itself more beautifully and artistically than when sailing through cloudland. While you may not hear the music of the crystalline spheres, you never fail to perceive the rhythm of nature's motion. The air-craft, when in equilibrio, is always turning on its vertical axis, not in a continued, regular, circular rotation, but in a pulsatory manner, like the ratchet-wheel in a clock. All the movements in nature are subject to this poetical order of measure. Noted modern scientists accept it as a universal law. Artificial motion, by whatever enginery produced, has to march and work to the nod of its baton.

When isolated in the atmosphere, above the sound and din of all

earthly noises, where the solemn silence of the vast solitude is so profound that you can hear the throbbing of your own blood, the mind becomes more intensified in contemplating the surroundings than it does in its action while on the surface of the earth, or even upon the sea. There is always some noise around when one is upon dense matter. Not so in the air. There you are entirely at rest with the bulk in which you float, and it matters not in the least whether you are sailing one mile an hour or one hundred miles an hour, the relative conditions are exactly the same.

On one occasion, in an ascent from Allentown, Pa., the atmosphere being studded with clouds, the air-ship ascended almost vertically into the cloud stratum, but after it shot up and through the cloud vault it passed into a current of air, into one of those swift aërial drifts, but almost imperceptibly to the senses. A band of music engaged on the occasion was playing, and only ceased as the air-vessel passed into the clouds. After being aloft forty minutes, and seemingly all that time over the precise cloud space from which the balloon emerged, the music was resumed in another tune; and as the sound resembled that of the music of the Allentown band, the natural inference was that the air had for once been perfectly still. To make an agreeable surprise, I determined to come down through the cloud barrier, probably near or into the enclosure whence the ascent had been made. But once in sight of land the mistake was evident. The anchor caught in a tree-top in Bucks county, forty-two miles from Allentown, and near to where a picnic party had been enjoying themselves with the band of music that was last heard. It seemed very strange, and, to garnish the conclusion, a rather ludicrous scene occurred. The wind being very brisk at the anchorage, it drew the hook through the limbs of the tree, upon which the balloon bounded upward, describing an onward curve of a mile in length. It was brought to bay by the anchor hooking into a farmer's plough, upsetting that, and starting off the horses on a run. Then it made another onward bound of half a mile, when it was brought to a stand, and the ploughman probably to this day never learned the cause of the stampede of his horses, for the whole thing passed so quickly that before his team was brought up in the fence corner the balloon had skipped over a strip of woods and was out of sight. I passed the grounds of the picnic party on my return, and heard again the music of the band which had deceived me.

# CHAPTER XV.

Ascent from Danville, Pa.—Appearance of the clouds—Passing over Pottsville—Orwigsburg—Schuylkill Haven—Atmosphere cold over mountainous regions—Appearance of a bread-basket thrown overboard—Its descent seen by persons below—Crossing Reading; its aspect—Pulsatory motion of balloon—Experiments on it—Descent—Warmth when sailing over valleys, etc.

THE next ascension worthy of note took place at Danville, Pa., in June, 1841. By reference to my aërial log-book I find that at two o'clock thirty-five minutes I lost sight of Danville, and in a few moments afterward passed into the clear sunshine above, when the gas began to expand and cause the balloon to ascend with an increased rapidity. The Susquehanna was now lost to my view by the intervention of clouds, and the country beneath presented one vast wilderness as far as the eye could reach; the atmosphere was extremely cold for the height over this extensive coal region. The clouds beneath me were sufficiently broken to afford me constantly recurring glimpses of things below, and I never before had found them so extremely diversified on their upper surface. On this occasion there were two strata, but not of that distinctive character which were met with in a former voyage. The lower bed was *cumulostratus*, resembling uneven and rugged precipices; the upper was more of a *cirrostratus*, and consisted only of patches here and there, but very high above the lower layer.

At two o'clock forty-five minutes I crossed the Pottsville road between the Bear Gap and Northumberland road, travelling at the rate of about fifty-five miles per hour. At three o'clock I crossed Pottsville, and again brought to view the cultivated fields of the husbandman. My altitude was so great that I could not recognize the town until crossing Schuylkill Haven and coming in sight of Orwigsburg. The cold atmosphere became so uncomfortable that it impelled me to descend; but after lowering some distance, I found the valley in which it had been my intention to descend had been passed, and the chain of Blue Mountains already reached, which required me to seek refuge in the clouds again.

At three o'clock forty minutes the clouds began to thicken beneath

me, so that I could at intervals only see the face of the earth. Perceiving a village which the balloon was about crossing, I threw from the car a new bread-basket which had been placed in it at the time of starting, intending to serve me as a temporary seat should I prolong my voyage. As it fell toward the earth, it presented a beautiful appearance to my view; it had not gone far before it assumed a rapid rotary motion, bottom downward, its upper being the concave side, looking like a beautiful rosette set into a circular motion on its centre. Its descent on the earth, as I was afterward informed, caused considerable astonishment to several persons who saw it coming down, they not knowing anything of the balloon above them at the time. At four o'clock I passed the town of Reading a little to the west of it. This place had a handsome aspect; the white streets crossing at right angles, and the beautiful spires and domes, white as snow, with their glittering balls and vanes, made the prospect highly interesting.

I found the atmosphere much colder in crossing this mountainous region than it usually is in crossing over a level and cultivated country at the same height. During this voyage I observed a peculiar motion in the balloon, which had on former occasions drawn some attention from me, but which had not been closely investigated. It was this: When a balloon is sailing along with a steady current, while in equilibrium with the atmosphere, it revolves slowly on its vertical axis. This rotation is not at all times a smoothly continued circulation, but is pulsatory, like the notched wheel of a clock which is actuated by the pendulum. At first I attributed this motion to my breathing, believing the vibration of the lungs sufficient to give a corresponding motion to so delicately balanced a thing as a balloon is when suspended in space. I held my breath as long as I could, and this was done several times, but the pulsations of the balloon were not interrupted by it; on the other hand, they seemed more audible during these experiments. Upon timing these pulsations, I found them to be every two and a half seconds, and this seemed to be regular, as far as my observations indicated. This left me at a loss to account for the motion, as it seemed not to be caused by my breathing, and did not correspond with the beat of my pulse.

At twenty-five minutes past four o'clock I descended near the house of Mr. Wm. McIlvain, near Morgantown, about seventy miles from where I started in a straight line, where I was cordially received by that gentleman and his hospitable lady.

My landing here was caused by mistaking the Downingtown turnpike road for the Pennsylvania railroad, which was some eight or ten miles farther to the south. During this voyage I also distinctly felt the difference of temperature in crossing large valleys, where a degree of warmth rose up quite congenial to one's feelings while in a frosty region. This, I presume, arises from a greater quantity of the sun's rays being

reflected upward from a valley than from level ground. I forgot to mention that the pulsatory motion of the balloon was not perceptible when it was rising or falling, and is only to be detected when the machine sails a considerable length of time at a great altitude in a steady horizontal direction. Fluctuations of the balloon by rising and falling from any cause soon neutralize this delicate motion.

## CHAPTER XVI.

Ascent from Lewistown, Pennsylvania—Figure of the town—Mountains and valleys—Their appearance—Juniata River—The narrows—Opinions of their formation—Viewing objects from high isolated positions—Regular order of nature—Ascent from Bellefonte, Pennsylvania—Black balloon—Effect of its color—Current from west to east—Ascent from Wilkesbarre, Pennsylvania—Unfavorable weather—Novel way of going up—Reference to second ascent from Danville—Letting persons up by a rope—Lady went up first—A mania ensued for going up—Profitable business.

A NUMBER of aërial voyages will now be passed over, with extracts only from the journals of some, and details of such when they are new, interesting and instructive; such as afford nothing but a repetition of what has been recorded will not be noticed at all.

In April, 1842, I made an ascension from Lewistown, Pa. After rising to a considerable altitude, as usual, symptoms of excited electricity were powerfully exhibited by the attractive force of the upper part of the balloon as it passed slowly through the eddy between the upper and lower currents of air. Rising above this point by a circuitous ascent, the country for many miles round became visible. The borough of Lewistown represented a figure like the letter Y. While still ascending, mountain after valley and valley after mountain sprung up out of the body of the earth as by magic. The sublime workmanship of Him that made the heavens and the earth burst upon the vision with amazing grandeur, and smiling Nature, clad in her vernal garb, looked up toward heaven with a pleasing countenance. For an hour or more new and beautiful scenes were continually developing themselves. The mountains appeared to range in astonishingly exact parallel semicircles, alternated by the gayer colored valleys between them.

The Juniata River, meandering through the mountains, added much to the beauty of the scene, and my attention was particularly drawn to that portion of the river which passes through the narrows just below Lewistown. The probability of the impression which has obtained with many persons—that the river has, by a sapping, percolating process, worked its way through the mountain—is entirely destroyed when the place is viewed from the point where I passed it. From there it has the

appearance of a natural formation coeval with the earth's adaptation to watercourses; and were it otherwise, it might have worked its way through some distance above by a shorter and apparently easier route, or continued seven or eight miles farther in the upper valley to where it blends with the one on the other side into which the river runs.

A calm and deliberate contemplation of the workmanship of the earth, when viewed from a high, isolated position, bringing it in view as a whole, leads the mind to very different suppositions and conclusions from what it would arrive at when viewing it from its own surface. This may be properly illustrated by the comparison of looking at a rivulet, or the great river that rises from a number of rivulets, or in viewing a single house or a whole city. The earth, when seen from a great height, assumes a regularity of order, skill and arrangement which cannot fail to strike the mind of an observer with admiration.

In May following I made an ascension from Bellefonte, Pa. The last paragraph of the log-book of that voyage says: "I have at present in use a black balloon, which creates a congenial atmosphere around itself in the cold upper regions of the air, from the radiating superiority of that color over a lighter one. It is now beyond a doubt in my mind established *that a current from west to east in the atmosphere is constantly in motion* within the height of 12,000 feet above the ocean. Nearly all my trips are strong proof of this."

Soon after this an ascension was made from Wilkesbarre, on a very unpropitious day. As it was a novel mode of going up, the account given by the "Wilkesbarre Farmer" may be quoted: "The day was unfavorable; the rain fell in torrents a short time before the aëronaut started, saturating the netting and silk of the balloon, and rendering it, therefore, necessary to dispense with the car. But the storm did not trouble the operator. He said he meant to go up, and he did go. A board about twelve by seven inches, notched at the end, was attached to the cords, and astride of this Mr. Wise went up most beautifully, cheered by the shouts of the people assembled. He made but a short trip, landing at the foot of the Kingston Mountain, west side of the river, on the farm of Mr. Joshua Pettebone, where every assistance was rendered, and especially by our friend Mr. Seaman, who, having a horse and buggy ready, put off the moment Mr. Wise did, and brought him and his balloon safely back in two hours from the start."

A number of ascensions of which the accounts have been omitted had nothing interestingly new or instructive connected with them, excepting, perhaps, the second one made from Danville, on which occasion I landed near to that place, and after coming down, offered to let some persons go up the length of a rope, which offer the bystanders, every one of them, refused to accept. At this time a rustic-looking young country girl came along from town, where she had been at the balloon ascension, and was invited by me to take a seat in the car, which she did, and was

soon let up two or three hundred feet, much to the satisfaction of herself and amusement of the bystanders. After hauling the machine down again and handing the young lady out of the car, I prevailed on a trumpeter who was now standing by with his instrument to make a similar adventure, which he did. When up, he gave a few blasts with his trumpet, which acted like magic in bringing the people across the Susquehanna bridge, which was between the place where the balloon now was and the town. Upon this a perfect mania ensued among them to get into the car and ascend the length of the rope, which was four hundred feet long, some going the whole length, others not aspiring to more than half, and some even less. Having first charged nothing, the business got too pressing, upon which a quarter of a dollar a trip was levied; and this not abating the pressure of business, it was raised to half a dollar per ride, at which it was kept up until I had realized eighty dollars, and was then only compelled to close the "fun" on account of the immense throng which had surrounded the balloon, making further operations in this way impracticable. Some paid for two, and even three, trips up before they left the car.

# CHAPTER XVII.

Ascension from York, Pa.—Two failures had been made there by Mr. Parker—Its effect on the people—The day for mine unfavorable—The populace would not have it put off—My predicament—Reason and compromise—Decision—People reasonable—"York Gazette" account of it—The start—Scenery and clouds—The balloon torn in the clouds—Consequences—Scene above the clouds—Phenomena—Thunder-storm—Brilliant image on clouds—Sensations—Reflections—Balloon speed—Descent—Another ascent provided for on my return—Extracts from "York Gazette."

WHILE I was remaining at Wilkesbarre, a very flattering invitation from Messrs. Glossbrenner and Morris, of York, Pa., who were then on a visit to the Wyoming valley, was tendered me, to come to their borough and make an ascension, which I cheerfully accepted. The late Mr. Mills, a very successful aëronaut, had made a very satisfactory ascension from York the summer previous, and died there while making preparations for a second.

A Mr. Parker, who professed to be an aëronaut, volunteered to make the ascension which Mr. Mills had made preparations for, but he failed in getting up with the balloon; he shortly afterward tried and failed again, which exasperated the populace to such a degree that it became necessary for Mr. Parker's safety to put him in the hands of the sheriff of the county. This double failure had a tendency to make the people of that county rather suspiciously inclined toward balloon experiments. Many of the country people believed it to be a plotting humbug in order to delude them into the town; others doubted the sincerity of balloonists' intentions of going up, looking at it as a dangerous business. These circumstances made it a delicate matter for me, in case I should be so unfortunate as to fail in getting up; and although I had now acquired a reputation as a "successful aëronaut," it only made it worse for me, in the event of any accident that might foil me in making the ascension according to announcement. The balloon which I had then in use was not throughout of strong material, being made of black silk, a part of which, being of a different texture from the other, was very mellow. However, an ascension was determined on, let the consequences come as they would. The last Saturday in August, 1842, was

appointed for the experiment; and as it was one fraught with interest on various accounts, a detailed description of it will be interesting.

As fate would have it, the day was ushered in with boisterous and stormy weather. The atmosphere was continually charged with black thunder-clouds, and incessant squalls of wind alternated the strong gale from the west which blew all day. The people, no ways daunted from the last summer's failures, poured into town in a continuous stream. Twelve o'clock came, the time for commencing the inflation, but it brought no hopes of success in case it should be attempted. The people began to gather around the enclosed arena, which occupied a large open common on the outskirt of the town, and frequent and determined were the threats from their lips of what would be done in case they should be "humbugged again." As the time passed on, my friends also became uneasy, they thinking I was rather timid. Thus things went on until near two o'clock, the time announced for starting on the voyage, and matters were coming to a crisis; already from eight to ten thousand persons had assembled on the common, and more than threat had already commenced to develop itself in some angry countenances. The last consolatory words from my particular friends were, "You are in danger of violence." I had remonstrated against their advice of going on, as I contended that a failure would be more fatal to all concerned than a postponement to a better day. But they told me a postponement was out of the question under the circumstances. Now, as I had no confidence in the strength of my balloon holding out under such squalls, and as a postponement would not be tolerated, I determined to reason with the people, and at once went to the outside of the arena, mounted a table, beckoned the immense crowd to listen to me for a minute, which, after one very refractory individual had been quieted, was granted.

I made a brief statement of facts and circumstances, as connected with the occasion, and mentioned to them that God made the weather, while I only professed to make ascensions, and then put the question to them whether I should go on under the circumstances, or postpone it to a better day, with a proviso, however, that they would buy tickets under the risk of a failure, and that they were not to mob me, nor suffer me to be mobbed, nor ask their money back, if I should fail on account of the weather. It was unanimously agreed that I should go on, with a loud promise, "We will stand by you through thick and thin." Just at this moment a gentlemen stepped up, who I learned was Doctor Ness, and in a proper and terse manner substantiated my explanations.

In another moment the gas retorts were in active operation, as no time was to be lost in getting the balloon inflated. This process had not gone on long before every one present began to realize the truth of my remarks. The balloon stood the blast, and at four o'clock was

sufficiently inflated to prepare her for the flight. As the inflation and start are sensibly and graphically described by the "York Gazette," its article relative to this occasion may be properly quoted:

"Mr. John Wise, the celebrated American aëronaut, made from an enclosure at this place on Saturday last one of the most beautiful balloon ascensions ever witnessed in Pennsylvania, or probably in the Union. An immense crowd was assembled to witness the ascension; the number is variously estimated at from six to ten thousand persons.

"There was quite a strong breeze early in the morning, and it continued to blow up to and beyond the hour at which the inflation was to have commenced. This occasioned some delay, as it is exceedingly difficult to inflate a balloon in a strong wind, and in four cases out of five when it is attempted the balloon is torn during the process. At about two o'clock, though the wind had not entirely ceased, Mr. Wise, anxious to gratify the thousands who had assembled, many of them from a considerable distance, to witness an ascension, determined, at the risk of destroying his new and costly balloon, to commence the inflation. Then the danger became evident to all; for although the wind was very slight, yet as soon as the balloon had been swelled by the gas to a height of six or eight feet, so as to present any surface to the wind, it became as fractious as a drunken Mohawk. Mr. Wise found it necessary to have the assistance of about a dozen of his friends, who were all kept quite busy in preventing it from tearing itself to pieces.

"The excellent preparatory arrangements, however, of Mr. Wise, and his unruffled temper and systematic method of conducting the process, overcame all the difficulties; and at about four o'clock he attached his car to its aërial steed, entered it as coolly as though about to seat himself for a ride upon an 'ambling pad pony,' and was launched, amid the cheers and shouts of congregated thousands, into the air.

"He cleared the enclosure by about ten feet, and sank a few feet immediately on the outside, but by throwing out a portion of his ballast he was enabled to rise sufficiently as he moved off beautifully in an easterly direction. He seemed, to those who saw him from the point at which he started, to rise as he receded, keeping on in one direction until lost to their view behind a cloud about five miles distant.

"We never saw a more gratified multitude than were assembled on this occasion. All seemed delighted, and to be at a loss for words to express their admiration of the sight presented by the daring aëronaut as he replied from his seemingly perilous height by a graceful wave of his hat to the cheers that continued to greet him as long as his features could be distinguished."

Narrative of the journal:

"At fifteen minutes past four o'clock the aërial ship United States was released from her moorings under a heavy blow from the south-west,

gliding swiftly near the surface of the earth until her ascending power was increased by the discharge of about forty pounds of ballast; when at a distance of several miles from the common, the ascent became very rapid. At eight minutes after the start I passed through some filmy clouds, going nearly parallel with the railroad all the time, and in a few minutes overtook the locomotive, which had started about fifteen minutes before the balloon did. At four o'clock thirty minutes I commenced penetrating a dense stratum of clouds, after having enjoyed a magnificent view of the country for thirty miles round, bringing into view over fifty towns and villages, innumerable streams of water, with the beautiful Susquehanna in their midst. On entering the clouds the atmosphere grew cold, but after passing through the lower stratum, and getting into the shadow of cloud patches far above the lower layer, the cold became so intense as to convert my breath freely into hoarfrost. I did not suffer much from this cold atmosphere, as the excitement of the day had supplied me with a fervor that lasted me through the whole voyage, and it would be a senseless being indeed that could pass through such scenes without excitement. While passing through the clouds, the balloon rising at a furious rate, I attempted to open the valve to discharge gas, but was prevented by the lower part of the balloon having so closely taken the valve-rope into a fold, it being flaccid, that it became impossible to work the rope through. This would of course become relieved through the expansion of the gas, which would unfold it as it would rise into a rarer region of the atmosphere; but as the balloon was mounting so rapidly, and the air quite cold enough already, I was determined to arrest its upward progress by a violent tug of the valve-rope, which succeeded in releasing it and bringing with it a strip of the balloon five feet long and seven inches wide at one end, tapering to a point at the other. This piece came clear out of the balloon and dropped down by the car, so near that I reached for it as it fell past. Being from the lower side of the balloon, it would cause no serious consequences, unless, in case of a rapid descent, it might, by the rush of air against it, cause it to slit upward and open the whole side of the balloon—an accident which would not endanger my life. After having risen some distance above the clouds into a clear sunshine, the temperature became more congenial, and a most brilliant cloud-scene lay beneath me, a spacious snow-white concavity, with here and there a pyramidical projection jutting from the common surface. To the south-east a violent ebullition in the cloud ocean indicated the formation of a thunder-storm, which soon developed itself in uprising cloud columns, discharging electric flashes and *rattling* thunder. The shadow of the balloon was visible on the surface of the clouds below, and after getting so high that it became completely distended, I discharged gas from the valve, while it was at the same time copiously discharging from the hole which had been made in tearing out the piece with the valve-rope. The gas escaping from the rent be-

low assumed a white, milky color. Looking down upon the clouds at this time, a most beautiful phenomenon presented itself, like that on the disk of a camera-obscura. Around the dark shadow of the balloon there appeared a bright blue ring, and on the outside of this ring, surrounding it, there blazed out a brilliant halo of fiery red. This splendid image increased and diminished in size as the balloon was lowered or elevated above the cloud stratum. I gazed on it until my eyes became dazzled and painfully affected by its brilliancy, and I could not refrain from ejaculating over the transcendent privilege of viewing such celestial grandeur; for at this time a combination of circumstances never before witnessed at one time conspired to make the scene grand beyond the power of description."

When my aërial ship had passed over the thunder-storm and got some distance ahead of it, I gradually descended, reaching the cloud ocean in five or six minutes; and when in this cold misty sea, my feelings became painfully depressed; the transition from so beautiful a haven assisted in no small degree in producing the gloomy and morbid sensations that followed. I really felt like an expelled intruder who had been driven from a usurpation. As soon as I got through this gloomy abode of the clouds and in view of as beautiful a prospect as the eye ever gazed on—the fertile landscape of Lancaster county—my spirits became somewhat revived. Besides, I was now viewing the place of my birth, the town, the street, the pleasure-grounds, of my youthful days; dreams, enchantments, realities, doubts, all seemed to have held their sway within the last hour. Such voyages are strange and exciting things.

After sailing over the city of Lancaster, my course was parallel with the Pennsylvania railroad, down which a locomotive was flying with a train of cars, which was soon overtaken and passed, showing that steam cannot compete with balloon speed when they both move in the same direction. At thirteen minutes past five o'clock I landed on the farm of William Hiester, Esq., near the village of New Holland, about thirty-nine miles from the starting-point, being at the rate of fifty miles per hour in the horizontal direction.

When I returned to York, the citizens had already contributed an amount considerably over and above the sum demanded by me as an inducement to make a balloon ascension, for another balloon voyage from their place.

This ascension took place on the 20th of August following, on which occasion the day turned out to be of fine, clear weather and a very calm atmosphere. The "York Gazette," in noticing this voyage, indulges in the following remarks:

"We considered his thirty-sixth ascension the *ne plus ultra* in grandeur, but it was far exceeded by the last. Mr. Wise, on this occasion, was favored by almost a perfect calm; and having cut his cord, he

ascended almost perpendicularly to a height of four or five thousand feet. He receded from the spectators so slowly that they could distinguish his features for about three minutes, and his form five or six minutes, after his departure. In all this time he was receiving and gracefully acknowledging the reiterated and thundering peals of applause from delighted thousands. We never witnessed a crowd so completely carried away by their feeling of unmixed gratification. They did not seem to be able to find words commensurate with their enjoyment; but every moment, shouts, spontaneous and simultaneous, would be sent up to the car of the aëronaut from countless throats, and the calm and collected occupant of the apparently frail vessel could be seen, with his head uncovered, returning the salutations as they reached him, from a height so tremendous that his form appeared to be reduced to the proportions only heard of in fairy tales. It is safe to predict that not one of all the vast crowd assembled on Saturday will ever again witness on earth a spectacle so unutterably grand and sublime as that presented by Mr. Wise in leaving the earth on his thirty-seventh aërial voyage."

In lieu of the account from my log-book, the above has been quoted. The voyage being over nearly the same course as in the one preceding it, and nothing of a new character having occurred in its progress, it would consist of a mere repetition of what has been said. The remarks of the "Gazette," however, go to show what enthusiasm prevailed at these exhibitions when they were conducted with system and decorum. The editor of the "Gazette" is a close observer of the progress of the age, and at this time paid particular attention to the practice and philosophy of aëronautics. The following is taken from his paper of that period:

"Curious Appearance of the Earth.—Clayton recently made a successful ascension in a balloon from Columbus, Ohio. Among the remarks in his journal of the aërial trip, we were struck by the following:

"'From the questions that I am frequently asked, an idea seems to exist with many that aëronauts lose sight of the earth when at a great height. This is a mistake; they never do, except when clouds intervene or night appears. On the contrary, the earth is always like an immense concave map, painted different colors, which designate not the different townships or counties, as maps generally do, but the various products of the soil.

"'That the earth, which, in reality, is convex, should appear to the aëronaut to be concave, may at first seem strange to many, but a moment's reflection will render it clear. His horizon is frequently upwards of a hundred miles from him. Draw a right-angled triangle, and make the base line fifty or sixty times as long as the perpendicular; the hypothenuse and base will then be nearly in the same line. The

horizon appears to the aëronaut to be on a level with the car of the balloon, but the part of the earth directly underneath him seems at a great distance from him; consequently, the whole surface of his scene appears concave.'

"Mr. Wise, in a very interesting lecture on the subject of aërostation, delivered by him at York, on Wednesday evening last, also mentioned the apparent concavity of the earth when seen by the aëronaut from his car at great altitudes. He also spoke of the entire absence of vertigo or dizziness when at the loftiest point in the air he has yet reached in his car. He states that he is as susceptible as others, perhaps peculiarly so, of the giddiness experienced so generally on ascending any considerable height; and we chanced to see him under the influence of this unpleasant sensation a few months ago as we sat together upon the highest point of 'Prospect Rock,' near Wilkesbarre, a point from which we could look down upon the lovely valley of Wyoming in its whole length and breadth. On that occasion we expressed surprise that he, accustomed as he was to ascend for miles into the air, should be rendered giddy by a situation that affected us but so slightly. He then made a remark which we recollected, on hearing it, to have been published somewhere, that the sensation is lost to the aëronaut *as soon as he becomes entirely separated from the earth.* While a single cord remains to attach him to the earth his steadiness may be seriously affected; but when the last connection is severed, he is not disturbed by a height that would under ordinary circumstances stagger the most daring, and send an iron-nerved man reeling from his elevation."

# CHAPTER XVIII.

Ascent from Gettysburg, Pennsylvania—Experiment on the spiral ascent of bodies—Refraction of light—Parhelion—Its effects—Waving motion like aurora borealis—Experiments on it—Peculiar brilliancy of a mountain scene—Peculiarity of atmosphere and clouds—Descent—Second ascent from Gettysburg—Made by an amateur—Historical description of it—Humorously but graphically written—Perilous descent of the amateur.

IN September, 1842, I made an ascension from Gettysburg, Pennsylvania, of which the following account was written at the time:

During the preparatory arrangements for my thirty-eighth aërial voyage, made from Gettysburg on the 10th inst., it was suggested by Professor Jacobs, of Pennsylvania College, in company with several other scientific gentlemen, to make some experiments upon the spiral ascent of the small balloons that were to be sent off as pilots. Having noticed that they revolved on their vertical axes when ascending, in a direction opposite to that of the revolutions of the hands of a clock lying with its face upward, Professor Jacob proposed that the remaining two pilots should be started with a rotary motion opposite to that which they assumed when let off uninfluenced. Accordingly, they were started with considerable impetus in that way, but that motion subsided in a very short time, and the other or contrary motion took effect, and continued as long as they could be seen, which was until they passed into the clouds. The large balloon also revolved in the same way on this occasion; and in pursuing these experiments, by throwing down, when above the clouds, substances of different kinds and shapes, they all fell with the same rotary motion. The atmosphere at the time of starting on my voyage, twelve minutes before 4 o'clock, was perfectly calm, and the upper heaven was completely partitioned off from the earth by a thin layer of clouds. The height from the earth to the clouds was 3900 feet by measurement. The atmosphere became slightly colder as I ascended higher, until entering the clouds, where it was somewhat warmer than just beneath them; and when entirely above them, the sun's rays had a powerful effect upon my body and upon the balloon, as its accelerated upward motion quickly told.

The phenomenon of refracted light, which had so much interested me

on a former voyage, made its appearance again upon the thin layer of clouds beneath, and my particular attention was now directed to its operation. The parhelion was this time more perfectly formed in regular prismatic rings, the cloud stratum being thin on which it was refracted, and consequently did not reflect so much dazzling light as before, when it was thicker. It appeared, too, on this occasion that the cause assigned for its production on a former voyage was not altogether essential, being a profuse escape of gas, as on this it originated from the mere diffusion of gas round the balloon. The air, being very calm, suffered the balloon to remain a longer time in the same spot, and consequently a rarer and more refractory medium would be formed around it, enhanced by the radiating power of its color (black).

The shadow of the balloon was well defined on the clouds, and the prismatic colors forming rings around it were brilliant; there appeared also another but dim shadow immediately opposite the main one, much narrower and fainter, and they each crossed or rather lay on the prismatic rings, as represented in the engraving, reaching from near the centre to some distance over the outer ring.

The smaller shadow was continually expanding and contracting, sometimes getting nearly as wide as the main one, and then contracting into a mere line again, resembling in its action the *waving* motion of the aurora borealis. This motion I thought might have been caused by the different degrees of thickness of the cloud stratum on which it was formed, as also by the difference of distance between the balloon and the surface on which it acted, as the clouds were moving along, while the air-ship was apparently becalmed; this would continually change the condition of space between the object and its shadow, as it would the density of the substance that formed its screen. The parhelion and shadows varied in size as the balloon ascended or descended, which I caused it to do several times to a degree of not less than six to eight hundred feet. What appeared most remarkable to me was the appearance of this phenomenon after the balloon had descended between the clouds and the earth. While coming down over an open space in the clouds, I noticed the parhelion disappear in it, and in another moment discovered it on the green surface below—a piece of woods—not with its regular rings, but in a red fiery halo, blending all the colors in it; and when it passed from the woods, it was still perceptible on the green fields, but more diffuse than when on the woods. When I got below the cloud stratum, the balloon moved slowly in a horizontal direction, at the rate of about a mile in eight minutes; and whenever it would pass an opening in the clouds, so that it fell in the sun's rays, the fiery halo made its appearance at the corresponding point on the surface of the earth. The appearance of the phenomenon on the earth's surface was much like the reflected glare in the sky, of a night, during a conflagration.

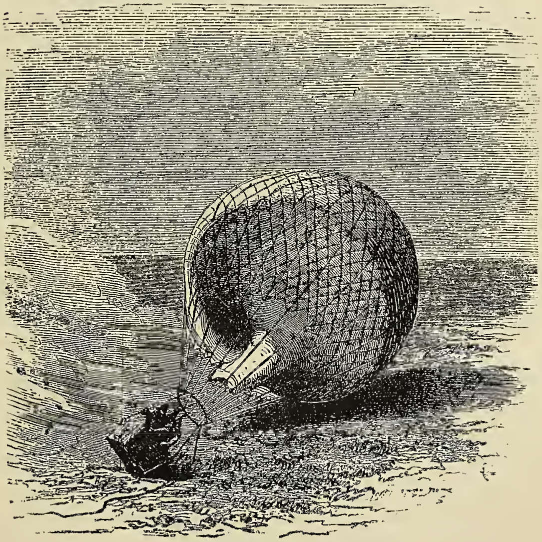
During the early part of the voyage, there appeared a magnificent sight in the west. No clouds being in that direction, at a point some miles off, a portion of the mountain region was receiving a flood of light from the sun, which gave it a peculiar lustre such as I had never seen before, though it has often happened that the sun was shining only in spots upon the earth which were visible to me. While in the clouds, I noticed them to have a more milky-looking aspect than is usually the case; and it was noticed by the spectators below, who informed me of it afterward, and they further remarked that "the balloon looked white" the moment of its submersion in the clouds, until it vanished from their sight. After I had been above the clouds for more than half an hour, I came down once so low that the spectators from the town saw the balloon for a moment, and they informed me that it was not far from the point where it had entered the clouds at the start, making it evident that the balloon was almost totally becalmed while above the cloud stratum. It was a peculiar state of the atmosphere throughout.

After remaining in the atmosphere eight minutes less than one hour, the greatest part of the time above the clouds, I came down to terra firma two and a half miles from the point where I had started.

These interesting facts were noted with as much precision and deliberation as if they had been observed from my private chamber, and they were submitted to my friend Professor Jacobs, who had been with me, during the inflation, engaged in observing the experiments made before the start, and it was he that took the altitude of the clouds.

The people of Gettysburg were so much pleased and interested with this ascension that they determined to have the experiment repeated a few weeks afterward. In the mean time, by their particular request, I entertained them with a public lecture on the subject of aëronautics in the court-house. Touching strongly upon the simplicity of the science during this lecture, and portraying the magnificent grandeur of its developments to the practitioner of aëronautics, it inspired some of the hearers with an indescribable desire for its enjoyments, but only one of them was willing to believe implicitly what I had said of its *non* danger as practiced by me. This individual was Colonel John M'Clellan, of Gettysburg. On the following day he made me a proposition to take him along on the contemplated voyage to be made in a few days from that place. The time being too short to make the extra arrangements necessary to carry another individual besides myself, I mentioned it to the Colonel, and at the same time informed him that if he did not wish to wait for another opportunity he might take my place on the Saturday following for half the price of what I had asked to take him with me, which would make it but fifty dollars instead of a hundred. He answered that he thought he would agree to this. I did not believe, however, that he would go by himself, inasmuch as we had already spoken of making it suit to take him up at Emmetsburg. When

FLOATING IN THE CLOUDS.



DRAGGING ON THE GROUND.

the day came for the ascension, the Colonel made his appearance about half an hour before the time announced for starting, gave me the fifty dollars security for the safe return of the balloon, and took some hasty instructions for the management of the machine while aloft, and also for effecting a systematic descent. These were promptly given him, and after this no persuasion, either from his brothers and sisters or from me, would induce him to relinquish his desire; and so I sent him up, confident that he would come down safe if he did not give up the ship, and my last injunction to him was, "Stick to the ship." He went up in gallant style, throwing out ballast until he mounted to an altitude of about two miles, and then passed out of sight. He went about twenty-five miles, landing a few miles west of York, Pa., and was from thence escorted into York by some dozen acquaintances, who saw the balloon descending, and finding with it, to their great astonishment, Colonel John M'Clellan, of Gettysburg, instead of the individual with whom they had an understanding to meet, if he would come down near York. Indeed, I regretted that I had to forego the pleasure of paying my York friends a visit via the clouds when I saw the favorableness of the breeze and the pertinacity of the colonel's intentions.

When he arrived at York and was surrounded by a host of friends, the Colonel was requested to give a detailed verbal description of his adventure, which he did, and with a great deal of accuracy, showing that before he commenced coming down he had been a deliberate observer. Mr. Glossbrenner, editor of the "York Gazette," being present, took notes, and made a publication of it in his next paper. It is written with some humor, but, nevertheless, with a graphicness and accuracy in regard to the appearance of things that could only come through the suggestions of an actual observer. This description has become historical, and is as follows:

"Ballooning Extraordinary.—A daring feat was accomplished on Saturday last, by a citizen of our neighborning town of Gettysburg. Mr. John Wise, *the* American aëronaut *par excellence*, had announced his intention to make his thirty-ninth balloon ascension on that day from an enclosure in Gettysburg, and with his usual punctuality was ready on the day and hour promised. His balloon was inflated, his ballast, grappling-iron, etc., duly stowed, and he was about to step into the basket. At that moment, Mr. John M'Clellan, a young gentleman of Gettysburg, inquired of Mr. Wise whether it would not be possible for *two* persons to ascend with the power then in the balloon. On receiving a negative reply, Mr. M'Clellan seemed much disappointed, said he was determined to have a ride, and inquired the price at which Mr. Wise would permit him to make the voyage alone. 'One hundred dollars, sir,' said Mr. Wise, who did not appear to consider the inquirer to be in earnest. 'I will give you fifty dollars!' 'Agreed—fork over!'

The joke was 'carried on,' and the *cream* of it was soon transferred to the pocket of the aëronaut, and his substitute was snugly seated in the car, vociferating his direction to 'cut loose.' Mr. Wise thought that matters had now gone far enough, and requested his customer to get out, as the time had arrived at which he had promised to be off. But he refused to do so, and insisted that he had regularly hired and paid for a passage 'in this boat,' and go he would. As Barney O'Reardon said to the man in the moon when the latter respectable personage told him to 'lave his hould,' 'the more he bid him, the more he wouldn't!'

"Mr. Wise then let up the balloon a short distance by a rope, thinking, probably, that, as there was considerable wind, and the air-horse consequently turbulent, his *substitute* would have his courage cooled, and 'give in.' But this was no go; and thinking that he had as good a start as ever he would have, Mr. M'Clellan cut the rope, *and was off*. After he found that it was the *determination* of Mr. M'Clellan to go, Mr. Wise had but time to give him a few hasty and imperfect instructions in regard to the management of the balloon, and in a few minutes the daring amateur aëronaut had ascended to a height of about two miles. Here he struck a current of air which bore directly toward York. He says that the earth receded from him very rapidly after he had thrown a bag or two of sand upon it, that Gettysburg passed off toward Hagerstown, and that he saw Carlisle, Hanover, Abbottstown, Oxford and Berlin strolling about; and that soon after, just ahead of him, he saw old York coming full tilt up the turnpike toward him, apparently taking an afternoon walk to Gettysburg. Having determined to stop at York, and fearing, from the remarkable speed at which our usually staid and sober town was travelling, that she would soon *pass under his balloon* and give him the slip, he pulled the string attached to the safety-valve, in order to let off a portion of gas. This valve is so constructed that when a rope attached to it is pulled the valve opens to the interior, and again closes by the force of a spring when the rope is let go. Unfortunately, however, the inexperienced aëronaut pulled too violently at the valve-rope, tore the valve-door completely off its hinges and brought it down into the car. When this occurred, he was more than a mile high, and he immediately, and with fearful rapidity, descended, or rather *fell*, to the earth. When the valve-door came off, the gas, of course, escaped rapidly, but the balloon caught sufficient air to form a parachute, by which the fall was moderated, and we are happy to say that the voyager reached the earth about five miles from York entirely uninjured. He says that as soon as the valve-door came down upon him he knew that something had 'broke loose;' and just then remembering that Mr. Wise had told him to be on his guard when he descended and throw out his grappling-iron, he was preparing to get at it among the numerous things in the basket, 'when the earth *bounced up* against the bottom of the car!'

"When first seen from York, the balloon was about thirteen miles off, nearly due west. It appeared to be approaching directly toward our town, until the valve was pulled and it had fallen considerably. As it fell, it seemed to find a current that bore it rapidly toward the north. The spot at which it landed is about north-west of our borough.

"The escape of the gas was distinctly seen from York; and as the balloon neared the earth, it had lost its rotundity, and appeared to the gazers here to come down *heavily*, like a wet sheet."

This was another proof of the efficacy of atmospheric resistance in bringing large surfaces falling through it down with a moderate velocity.

# CHAPTER XIX.

Balloon campaign of 1843—Trans-Atlantic project—Ascent from Carlisle, Pa.—Rev. Mr. Thorn's communication—Account from aërial log-book—"Beautiful and interesting spectacle"—Mr. Forney's description—Landing at Lancaster—Entry in the city—Reascension from Centre Square—Descent, etc.

IN the spring of 1843 the inhabitants of Carlisle, Pa., invited me to make an ascension from their borough. During the winter which had just passed, I had consulted some gentlemen of the city of Philadelphia upon getting up a project for crossing the Atlantic with a balloon. From the facts and deductions laid before them, they were willing to promote the enterprise in case I would undertake it. This stimulated my exertions to a furtherance of this project, and I had determined to spend all my time and talent in its consummation. But as soon as these gentlemen saw that my whole energy was directed in that way, they began to evince conscientious scruples as to the responsibility that would fall on them in case of my being "sacrificed to my too ardent convictions" of success, and so my fond hope was doomed to disappointment. I determined, however, to try Congress at its next session, thinking that I could give them facts sufficient to induce them to appropriate so trifling a sum as it would require to consummate this first step in an art that promised so much benefit to the human family. As I could now do no better, I concluded to make a summer's campaign of aërial voyages, and accordingly went on to Carlisle to begin, intending at the same time to keep in view and embrace every opportunity that would tend to enable me to carry out my great idea.

The ascension from Carlisle was announced to come off the third Saturday in May, 1843. It turned out to be a very interesting one, as I had promised my friends in Lancaster city to visit them via the *atmospherical current that always blows from west to east* in the higher regions of the air.

Rev. Mr. Thorn, of Carlisle, a gentleman of the highest integrity and well-trained scientific mind, took a lively interest in the experiment, and is the author of the following eloquent description of the first balloon ascension made from that place:

"The balloon ascension advertised by Mr. Wise, the celebrated aëro-

naut of forty aërostations, took place in this borough on Saturday last. The day was preceded by clouds and gusts of wind, followed by rain, accompanied with the most vivid flashes of lightning and heaviest peals of thunder with which we have been visited for a length of time; and indeed, so marked, according to human calculation, was the appearance of a continuation of such weather, so subversive to successful exhibitions of this kind, that many persons imagined the feat would be abandoned or deferred. At about nine o'clock in the forenoon, however, the clouds began to disperse, and the sun, that bright orb of day, displayed his Creator's power by dispelling the mists and density of the atmosphere in which we had been enveloped, and substituted in its stead the most clear and effulgent sky we ever beheld. At ten o'clock hundreds of persons from various parts of the adjoining country began to rush into our town, and to collect in various groups in our principal streets, which, together with the appearance and drill of Captain Washington's superior company of U. S. mounted artillery, with their cannon and accoutrements, gave an enlivening and imposing scene to our borough. Soon after twelve o'clock the process of inflation of the balloon was commenced; at two o'clock preparatory arrangements were made by Mr. Wise for his ascent, which in half an hour were ready. Previous to it, however, he with great politeness came forward, and in a very respectful manner gave an invitation to the ladies composing the assemblage within the enclosure to approach within the limits prescribed for them, that they might have a more clear and distinct view of the interesting scene they had convened to witness, which they accepted. He then proceeded to an interchange of salutations with the friends and acquaintances he observed around him, bade Mrs. Wise and his son, a promising lad of six years of age, an affectionate farewell, but with the entire confidence that the separation would be temporary—an absence of a few hours only. After which, making a general obeisance to all around, he stepped into what appeared to us a little brittle and insecure basket, with a fearless, unfaltering and dignified mien. He then examined with composure the various articles which had been deposited therein, apparently with a view to adjust their balance, and to ascertain whether anything which might be required on his voyage had by any omission been left behind. Perceiving, to use a familiar phrase, 'that all was right,' and that the most intense interest was depicted in the countenance of every beholder, he gradually but beautifully and majestically ascended, amid the cheers, plaudits and acclamations of the surrounding multitude, and the transporting strains of a fine band of music discoursing an inspiring tune. Thus did the successful aërial navigator depart from the scenes of terra firma, to indulge from his cloud-girt height in fancy's visions on the baseless fabrics 'of the world's ideal' and of the skies unknown.

"The balloon arose, diverging but little from the direct line with

which it set out; and the aëronaut continued several hundred yards above the spectators for a considerable time, waving his hat in recognition of the cheers which were complimenting him from below. The atmosphere calm and the sky serene, he remained in sight nearly an hour, some viewing him with telescopes while he could no longer be seen with the naked eye. The following memorandum, being a description of the voyage, and written by Mr. Wise during his voyage, will doubtless be read with absorbing interest by every one. An incident related by him, relative to his descent at Lancaster, tends to increase the confidence that is already reposed in him as a scientific aëronaut, and of the management and direction he is capable of giving to his balloon. He had informed his friends and acquaintances at Lancaster that it was his intention to land there on this occasion, as it lay *east* from Carlisle—a direction he says he can always attain—and visit his domicil. The citizens, being thus apprised of his design, were awaiting his arrival; and when he came within a distance of being heard, they called aloud to him, and said, 'Wise, you have redeemed your pledge!'

"Such being the favorable circumstances under which this experiment was made and ended, permit me to observe that the remark is occasionally made, in opposition to the science of aëronautics, that inventions of this kind are not to be encouraged or witnessed, because, through the perversion of men, they occasionally lead to vain and pernicious amusements. Admitting this to be the case, is that a reason why it should be decried and condemned any more than many other useful arts? But the objection usually, if not invariably, arises from persons of narrow minds and contracted views relative to the progress of the human mind in the enlightening and renovation of mankind. Air balloons are destined ere long to be brought to such a state of perfection, and be made capable of raising and carrying so much weight, as to be applied to highly useful and important purposes. Let encouragement be given to these experiments; let 'the soul of fire, the invention ever new,' the 'lively cheer of vigor born,' and the incitement to continual exertion, both mental and bodily, by the emulation of ingenious men, be patronized sufficiently to enable them to conduct their operations on an extensive scale, and time and experience will make them subservient to numerous philosophical uses, and bring to light many things which pass in the atmosphere, such as the formation of rain, of thunder-storms, of vapors, hail, snow, comets, meteors in general, and which, for the want of a method of ascending into it, cannot be known with precision.

"They may tend also to the general improvement and amelioration of mankind, in effecting the designs of a beneficent Providence to a lost and ruined world. Is it not possible—nay, is it not probable—that ere long, if suitable inducements be held out to the promoters of this science, a contrivance or means of conducting expeditions through the

atmosphere in a horizontal direction will be discovered, by making these machines subject to the helm of the aëronaut? And if so, may they not be converted to purposes of mercy by exploring countries hitherto inaccessible, bringing together parts of the earth which are now estranged to each other, and spreading knowledge to all mankind? Many are the good and sensible men who are of the opinion that every part of the habitable globe must yet be explored and its inhabitants visited with the salvation of God. And who knows but that by balloons this may be effected? Who will have the presumption to say that such a consummation will *never* be realized? And if *realized*, will it not present a literal fulfilment of 'Angels flying through the midst of the (aërial) heavens, having the everlasting gospel to preach to them that dwell upon the earth, and to every kindred and nation'?

"To these high and beneficent purposes we may add the gratification of curiosity and pleasure as a very strong inducement to the encouragement of the practice of the art, in which, with any tolerable degree of caution and information, there appears very little of real danger. We have heard from Mr. Wise, and all who have tried the experiment testify to the same, that the beauty and grandeur of the prospect afforded by an aërial excursion cannot be exceeded, much less described. Nor do aëronauts ever experience the least of that giddiness consequent upon looking from great heights connected with the earth; nor have they any of that sickness arising from the motion of a vessel at sea. Many have been carried by balloons at the rate of thirty, forty and fifty miles per hour, without feeling the least inconvenience or even agitation of the wind, for the reason that the machine moves with the wind and its velocity."

The following is an extract of the most important part of the journal kept on the occasion: Left the earth at two o'clock thirty-five minutes, the lower current of wind from south-west moving moderately. At three o'clock I passed on the south side of Mechanicsburg at an altitude of about a mile and still ascending. When at a considerable height above the clouds, another current blowing from north-west was encountered. This gave me an opportunity of making north or south latitude while pursuing my voyage eastward, as the occasion required, by sailing with one or the other of these currents. While nearing the Susquehanna River a magnificent view was opened; York, Carlisle, Harrisburg, and even Lancaster were embraced in this grand panorama, with all its innumerable villages and variety of splendid scenery. Upon its beauty I will not attempt to descant; it must be witnessed to be appreciated. Although the Creator has allowed me to enjoy this sublime privilege, he has not endowed my humble capacity with language adequate to express its grandeur. In viewing this scene of earthly glory I was forcibly struck with the idea that man is not of near so much importance in the eyes of Deity as he presumes himself to be; that he is no more to the Creator than the

minutest animalcule is to man. And now, in reference to the puerile fanaticism of "Millerism," I would remark that the world, clothed in her verdant summer garb, looked so young and so beautiful, and so far from having any appearance of decay or an intention of committing suicide by elementary self-destruction, that she reminded me of a gay and blooming maiden just emerging from the days of her innocence into sober womanhood. If any of the deluded followers of Miller doubt this, let them go aloft of a fine summer's day and view the earth; and if they then don't abandon their nonsensical views, nor feel ashamed of their narrow-minded conceptions of the goodness and greatness of their Creator, they must indeed be weak in the spirit as well as in the flesh.*

At three o'clock twenty minutes I passed over a vast body of clouds which reflected a powerful heat against the balloon, causing it to rise to a great height while in the field of reflected rays, and, therefore, obscuring from my view Harrisburg, and to the south, as far as York, the whole of the country. The current below, however, being nearly at right angles in its direction to that above, very soon cleared the space beneath me. My course now lay down the west side of the river. Seeing the necessity of making more south latitude, in order to make my port, until a point was reached nearly over the mouth of Codorus Creek, I soon after descended into the lower current, coming from the south-west, by which I could reach a point near the city of Lancaster, which was now in full view. This took me over the town of Marietta a little after four o'clock, and almost in a direct line for Lancaster. At fifteen minutes before five o'clock I reached a point within a few hundred yards of the city bounds, where I came down. Seeing the people rushing out of the city, a-foot and a-horse, old and young, great and small, rich and poor, accompanied by strains of music and the ringing of bells, I was soon encircled by my fellow-citizens of Lancaster, into whose custody I most cheerfully submitted myself, and will now let the balance of this interesting experiment be detailed by my old and esteemed friend John W. Forney, Esq., then of the "Intelligencer and Journal," and now of the Philadelphia "Press," who was an eye-witness of the scene:

"About a quarter before four o'clock on Saturday last, a black speck no bigger than a man's hand was seen a little north-west of this city. Some pronounced it one of Miller's 'signs'—some declared it to be a new and unrecorded phenomenon; and while all were thus arguing as to its character, the speck grew larger and larger, until, at last, the impression began to prevail that it was no less a personage than the great aëronaut, our townsman, Wise, who had started that afternoon from Carlisle, a distance of fifty-four miles by railroad; and with a precision equal to that of the recent discoverer of aërial navigation in England, he had *directed* his chariot with such admirable generalship through

* The Miller fanaticism was raging at that time in the neighborhood.

the regions of space as to hang suspended, a little more than two hours after his departure from Carlisle, over his native city. The day was one in which all the clearness and moderation of May were combined, and the whole of the town had an opportunity to enjoy the rare and interesting sight. As the aëronaut gradually approached our ancient city, his balloon slowly increasing its dimensions, every man, woman and child was out to watch its movements. At last, after having hung for nearly an hour in full view, he calmly and gracefully descended in his chariot of the clouds, a short distance south-west of the city, where he was followed by crowds of horse and footmen.

"Supposing all to be over, the curious spectators retired; when, about five o'clock, the whole town was again astir to witness the aëronaut's triumphal entry into his native city. This was a singularly novel and interesting sight. Standing in the car of his balloon, the huge globe above still distended, almost touching the sides of the houses and apparently eager for flight, he sailed through the streets at a slight elevation from the ground, his airy chariot drawn, or rather *guided*, by a number of young men and boys who had attached themselves to the rope which led from his car. In this way, with hat in hand and amid the cheers of his fellow-citizens, Mr. Wise passed through West King street and halted in Centre Square, immediately fronting North Queen street. Here he was again greeted with the cheers of the people; but the sport was not yet over. After a rest of about fifteen minutes, it soon became evident that Mr. Wise was about to attempt an ascension from Centre Square—a rather contracted area, by the way, and too much walled in with houses, we should suppose, to make a balloon ascent either safe or pleasant. But Mr. Wise is not one of your holiday soldiers; his whole demeanor on Saturday proved him to be cool, collected and intrepid, even to a fault. Having divested himself of nearly all his clothing but his pantaloons, even to his shoes, and detached the car from the balloon (the gas having been expended so much as to render the balloon incapable of carrying a heavy load), Mr. Wise took his seat on a narrow board attached to the cords of the balloon; and giving the signal to 'let go,' away he shot like an arrow from a well-strung bow and nearly in a straight line, leaving behind him hundreds who were amazed at the singular boldness of the daring feat. He ascended, we should suppose, nearly a mile, and was fast fading from sight, when he began to descend, and actually alighted about two squares from the place of starting. This unparalleled performance was accomplished with great ease and rapidity, and proves Mr. Wise to be an able and experienced aëronaut. When he reached terra firma, he was again taken in charge and escorted or rather sailed to his residence, through North Queen and East King streets, where he was congratulated by the hearty cheers of his fellow-citizens.

"Taken all together, last Saturday evening will long be remembered

with pleasure by our citizens. It was no less gratifying to Mr. Wise to make so grand a triumphal entry into his native city than it was to his friends and fellow-citizens to see the skill and ability he displayed in managing his steed of the air. We are pleased to learn that a handsome collection was taken on the spot, as an earnest of the public gratification, and paid over to Mr. Wise."

## CHAPTER XX.

Determination to cross the Atlantic by balloon—Intention of proclamation—Publicity of it—Comments on it—"Ballooning extraordinary"—Another extract—Volunteers for the project—Officers of the navy—Their letter.

AFTER my Carlisle ascension, I again appealed to my friends for their assistance to enable me to carry out the trans-Atlantic project, but got no farther with them than a promise to advocate the petition which I had determined to lay before the next Congress. Believing that something would certainly come out of that, and always looking ahead in matters of this kind, I deemed it advisable to make a sort of a world's proclamation of the contemplated enterprise, which was done for the following reasons: Although I believed, and do still, that the *solar current* which I have invariably found above blows clear around the earth, still, a voyage across the Atlantic might subject the navigators to local currents and storms, and, at best, to all the omissions, imperfections and unforeseen exigencies attendant upon all first trials of this nature; consequently, there should be a general knowledge abroad before the experiment is made, so that, in case of the balloon giving out from any cause while over the ocean, any ship at sea being in sight of it would come to its assistance.

I prepared the proclamation and handed it to Mr. J. W. Forney, of the "Lancaster Intelligencer," who prefaced it with his own remarks, and a number of speculative commentaries were written by other persons concerning it as it passed through the newspapers. Some of these will be related, and it will be observed how difficult it is, in looking at new projects, to separate the *ideal* from the *real* merits of the case. However, the proclamation went forth into the world, and the *substance* of it will some time follow, just as certain as steam followed horse-power.

"AËRIAL VOYAGE ACROSS THE OCEAN.

"The following announcement of Mr. Wise, the distinguished aëronaut, is one that cannot fail to excite public attention in a very great degree. Though the scheme may look somewhat Quixotic,

we have no doubt Mr. Wise possesses the nerve to attempt, and we believe, has the ability to carry it out. Our New York friends, therefore, must not be astonished to see our intelligent and scientific aëronaut arrive in their city next year with his 'large balloon,' and take his departure thence for the regions of the Old World. Would it not create a stir that would far exceed the reception of a hundred Presidents, though every man was a Tyler? And then what a sensation he would produce in England, as, coming along the Channel, he made preparations to settle down his aërial chariot in the heart of the great London world! or, missing this, suppose him dropping in upon the Frenchmen, at Paris, or Calais, or Bordeaux; or, going farther still, suppose him wafted into Constantinople, dashing down unceremoniously and without notice to the Sublime Porte! Why, our townsman would become more justly renowned than did Captain Ross in his voyage to the North Pole, or Lewis and Clarke in steering up the Mississippi; or the ambitious searcher after the still mysterious source of the Nile.

"Mr. Wise speaks for himself, however, in a tone of easy confidence that will surprise no one who knows his courage and resolution:"

"J. W. Forney, Esq.: You will confer a favor to the enterprise in contemplation by giving the following proclamation publicity, for general notice to the civilized world:

"TO ALL PUBLISHERS OF NEWSPAPERS ON THE GLOBE.

"As it is my intention to take a trip across the Atlantic Ocean with a balloon in the summer of 1844, and as the descent or landing of balloons, in my experience, has almost universally created unnecessary alarm and consternation to the people near by, I therefore give this general notice to the seafaring community of all climes that should they, during any time henceforth, chance to be in the vicinity of a balloon, either on the ocean or in the atmosphere, they need not be under any apprehensions, but should endeavor to give aid to its passengers.

"It must not be inferred from this that its success is considered improbable, but merely to be prepared for all emergencies.

"Having, from a long experience in aëronautics, been convinced that a constant and regular current of air is blowing at all times from west to east with a velocity of from twenty to forty, and even sixty, miles per hour, according to its height from the earth, and having discovered a composition which renders silk or muslin impervious to hydrogen gas, so that a balloon may be kept afloat for many weeks, I feel confident, with these advantages, that a trip across the Atlantic will not be attended with as much real danger as by the common mode of transition.

"The balloon is to be one hundred feet in diameter, which will give it a net ascending power of twenty-five thousand pounds, which is sufficient to make everything safe and comfortable. A seaworthy boat is

to be used for the car, which is to be depended on in case the balloon should fail to accomplish the voyage. The boat is also calculated on, in case the regular current of wind should be diverted from its course by the influence of the ocean or through other causes. The crew to consist of three persons—viz.: an aëronaut, a sea navigator and a scientific landsman.

"Therefore, the people of Europe, Africa, Asia, and all other parts, on the ocean or elsewhere, who have never seen a balloon, will bear in mind that it is a large globe made of cloth, enclosed in a network, with a sloop hanging underneath it, containing the latest news from the United States, and for crew the world's obedient servant.

"LANCASTER, June, 1843."

This announcement was generally published throughout the Union and throughout civilized Europe; and although its substance has not yet been accomplished, its postponement to the present time is attributable to a single cause—want of pecuniary means to do it *right.*

The following is another among the many commentaries that were elicited by the announcement; and although it breathes a progressive and well-tempered spirit, it is nevertheless strongly tinctured with that inseparable sentiment, so common to human nature, which undervalues projects that emanate from persons with whom we are intimately acquainted, and who have never *yet* accomplished great undertakings. However, the article contains so much good sound sense along with its humor and irony that I will cheerfully bear the latter, in consideration of the former, and publish it for what it is worth:

"That daring and (as the phrase goes) intrepid aëronaut Mr. John Wise, of Lancaster, has issued a formal proclamation to the world, announcing that in the summer of 1844 he contemplates making a balloon voyage across the Atlantic, having from long experience in aëronautics become persuaded that such a mode of transition is not only feasible, but attended with fewer risks than those in ordinary use. He deems this timely notice due the seafaring community, who in looking aloft may chance to descry him in the clouds, and who might otherwise be induced to class his 'coming' among the many mysterious 'signs and wonders' of the age.

"But, pray, why should not a trip across the Atlantic in one of these silken cloud-coaches be entirely practicable? To *us*, it is true, the project may look like the effervescence of a disordered intellect, and we may decry the undertaking as part and parcel of the impossible; but how many years is it since the man who first threatened to cross the ocean in a simple steam-carriage, with no *sails* but a kettle filled with boiling water, was laughed at as a creature fit only for the friendly ministrations of the keeper of a mad-house? A shaved head and a strait waistcoat were the promised rewards of the original projector of that most noble

enterprise. And yet the foaming billows of the great deep are at this day hourly plied by the rushing steamship, bounding and puffing recklessly along, as though it were itself the victim of the madness ascribed to its projector, but landing, nevertheless, its precious freight unharmed upon the distant shores. Now, if such stupendous and astonishing results *have been* realized, what may not man, under the irresistible dominion of the great master-spirit of the age, *Progress*—what may he not accomplish? If the one event has been taken out of the narrow bounds which encircle the diminished catalogue of impossibilities, and has only, like the rising and setting of the sun, ceased to astonish because of its familiarity, why may not the exercise of human effort also consummate the other? And then, after Mr. Wise shall have once successfully pioneered the perilous pathway, and demonstrated that fewer lives are lost by travelling in balloons than by steam and canvas, why should it not ultimately become the universal means of locomotion? Why not, under the guidance of skilful and experienced air-navigators, also adapt balloons to the uses of commerce, as a means of import and export? If men, women and children can be suspended for weeks over land and sea in vessels of silk upheld by gas, and ultimately reach in safety their places of destination, why not also thus convey the chosen product of every land and clime? Why not *balloon* a load of cotton at Charleston, and in a few days receive the vessel 'bock agen,' freighted with British cloths or a cargo of teas from the 'Celestial Empire'? And then, too, such a 'reform' would spare to our trusty and well-beloved benefactor Uncle Sam the necessity of maintaining at such a heavy expense the *navy*, there being no longer any use for ships and the like, although it might, in turn, subject him to the almost constant tricks of smugglers, owing to the uncertainty of the landing-places. If, therefore, we have not ourselves been all this time engaged in building 'air castles,' Mr. Wise may yet be destined to *soar above* the fame of such common men as Robert Fulton and Oliver Evans."

Another writer says: "We publish below an announcement of the enterprising and intrepid aërial voyager Mr. Wise, proclaiming his intention of crossing the Atlantic in a balloon. We are not prepared to express an opinion as to the feasibility of this project, but we do not doubt that Mr. W. is ready to attempt it."

Such were some of the numerous commentaries and opinions upon this contemplated expedition, which is *yet* to give the art an impulse that will waken the public to its real merits. Men believe in great inventions and discoveries after they have been accomplished, but if some people did not believe in them before, civilization would make but slow progress. The following letter, received by due course of mail, post-marked New Castle, Delaware, June 28th, shows that there were not wanting proper persons necessary to fit out the expedition under skilful management:

"Philadelphia, June 28, 1843.

"Mr. Wise:

"Sir: Perceiving by the newspapers that you meditate an attempt to cross the Atlantic Ocean in a balloon next year, and that it is your intention to have with you a scientific person and a navigator, and as we heartily enter into the spirit of your enterprise, and at the same time place every confidence in your ability to complete the undertaking, we cheerfully offer you our services in the latter capacity (that is, as navigators).

"If you should conclude on accepting of our company, we are in hopes you will inform us at as early a period as possible, so that we may signify our wishes to and obtain the necessary permission from the Navy Department.

"Very respectfully, your obedient servants,

"ARCH. M'RAE,
"SILAS BENT,
"*Passed Midshipmen U. S. Navy.*"

# CHAPTER XXI.

Second ascent from Carlisle—Editorial note of it—Narrative—Entering a storm cloud—Hoarfrost in it—Hail and snow forming in it—Could not get out of it—Terrific predicament—Remained in it twenty minutes—An age of time it seemed—Escape from it, and descent—Petition to Congress for an aërial project.

ON my return to Carlisle it was determined that I should be requested to make another ascension, as the first had only enhanced the desire for a second, in those that witnessed it, and many people from the surrounding country who had not seen it were now very anxious for an opportunity of witnessing such an achievement. Consequently, the 17th of June was appointed for the occasion.

One of the newspapers prefaced the narrative of this voyage in the following terms:

"Our own thoughts were a good deal bent toward Bunker Hill on Saturday, but nevertheless we had on the same day, in our town, a spectacle of an *elevated* character and of a thrilling and exciting interest. As upon the former occasion, Mr. Wise's forty-first ascension with his balloon drew together an immense concourse of the 'beauty and chivalry' of Cumberland and Perry counties. It is not necessary to say more than that it went off with the greatest *eclat*, and seemed to have given the greatest gratification to all who witnessed it.

"We are indebted to Mr. Wise for the narrative of his aërial voyage which is subjoined. It will be seen that he encountered insuperable difficulties and not a little danger, which brought him back to earth again after a trip of a few miles. Mr. Wise is to be congratulated on his safe and fortunate escape from the dangers of that 'long, low, black' cloud, which, from his description, one might judge to be the very dominions of the evil 'prince of the powers of the air.' The narrative possesses much interest."

## NARRATIVE.

According to announcement, I started on Saturday last on my forty-first aërial excursion from the Centre Square of Carlisle, at precisely fifteen minutes past two o'clock in the afternoon, it being on the 17th

of June, 1843. A slight breeze from the west wafted me a short distance in its direction horizontally, after which the ascent became nearly perpendicular until the height attained was about 2500 feet, when the balloon moved off toward the east with a velocity much greater than that of its ascent. The first thing that drew my attention was the immense ocean of heads that was presented in the square below. There appeared to be infinitely more people on the immediate ground than was usually the case, and the whole scene was rendered highly animated and imposing by the fine appearance of the military, and their repeated salutes of thundering artillery, at the departure of the "Comet." When I had reached a point about two miles east of the town, there appeared, a little distance beyond and above me, a huge black cloud. Seeing that the horizontal velocity of the balloon would carry it underneath and beyond the cloud, rising slowly as it did, and being desirous to gratify the spectators with the novelty of seeing a balloon pass through a cloud, preparations were at once made to effect it by throwing out some ballast as soon as its border should be reached. Harrisburg was now distinctly in view, and the balloon moving directly for it; I was hesitating, with the bag of ballast in my hand, whether I should throw it out for the purpose designated, or continue straight on as I was then going to the place just mentioned. By this time I had reached a point underneath the cloud, which was expanding, and immediately felt an agitation in the machinery, and presently an upward tendency of the balloon, which also commenced to rotate rapidly on its vertical axis. I might have discharged gas and probably have passed underneath it; but thinking that it would soon be penetrated, and then might be passed above, as it appeared not to be moving along itself, I made no hesitation in letting the balloon go on its own way. This part of the feat, however, I had reason to regret soon afterward, although at the present time it gives more real pleasure in contemplating its terrific grandeur and reality than anything that has ever transpired in my aërial adventures. The details that shall here be given of this terrible scene may be relied upon, as I was sufficiently composed to appreciate its grandeur and observe its physical operations. The cloud, to the best of my judgment, covered an area of from four to six miles in diameter; it appeared of a circular form as I entered it, considerably depressed in its lower surface, presenting a great concavity toward the earth, with its lower edges very ragged and falling downward with an agitated motion, and it was of a dark smoke color. Just before entering this cloud, I noticed, at some distance off, a storm-cloud, from which there was apparently a heavy rain descending. The first sensations I experienced when entering this cloud were extremely unpleasant. A suffocating sensation immediately ensued its entrance, which was shortly followed by a sickness at the stomach, arising from the gyrating, swinging motion of my car, causing me to vomit several times in quick succession most

violently; this vomiting, however, soon abated, and gave way to sensations that were truly calculated to neutralize more violent symptoms than a momentary squeamishness. The cold had now become intense, and everything around me of a fibrous nature became thickly covered with hoarfrost, my whiskers jutting out with it far beyond my face, and the cords running up from my car looking like glass rods, these being glazed with ice and snow, and hail was indiscriminately pelting all around me. The cloud at this point, which I presumed to be about the midst of it, from the terrible ebullition going on, had not that black appearance I observed on entering it, but was of a light, milky color, and so dense just at this time that I could hardly see the balloon, which was sixteen feet above the car. From the intensity of the cold in this cloud I supposed that the gas would rapidly condense, and the balloon consequently descend and take me out of it. In this, however, I was doomed to disappointment, for I soon found myself whirling upward with a fearful rapidity, the balloon gyrating and the car describing a large circle in the cloud. A noise resembling the rushing of a thousand milldams, intermingled with a dismal moaning sound of wind, surrounded me in this terrible flight. Whether this noise was occasioned by the hail and snow which were so fearfully pelting the balloon I am unable to tell, as the moaning sound must evidently have had another source. I was in hope, when being hurled rapidly upward, that I should escape from the top of the cloud; but as in the former expectations of an opposite release from this terrible place, disappointment was again my lot, and the congenial sunshine, invariably above, which had already been anticipated by its faint glimmer through the top of the cloud, soon vanished with a violent downward surge of the balloon, as it appeared to me, of some hundred feet. The balloon subsided only to be hurled upward again, when, having attained its maximum, it would again sink down with a swinging and fearful velocity, to be carried up again and let fall. This happened eight or ten times, all the time the storm raging with unabated fury, while the discharge of ballast would not let me out at the top of the cloud, nor the discharge of gas out of the bottom of it, though I had expended at least thirty pounds of the former in the first attempt, and not less than a thousand cubic feet of the latter, for the balloon had also become perforated with holes by the icicles that were formed where the melted snow ran on the cords at the point where they diverged from the balloon, and would by the surging and swinging motion pierce it through.

I experienced all this time an almost irresistible inclination to sleep, notwithstanding a nauseating feeling of the stomach, causing me to vomit several times, and the terrible predicament I was placed in, until, after eating some snow and hail mixed, of which a considerable quantity had lodged on some canvas and paper lying in the bottom of the car, I felt somewhat easier in mind and in body (for it is no use to say

that I cannot be agitated and alarmed), and I grasped a firm hold of the sides of the car, determined to abide the result with as much composure as the nature of the case would admit; for I felt satisfied it could not last much longer, seeing that the balloon had become very much weakened by a great loss of gas. Once I saw the earth through a chasm in the cloud, but was hurled up once more after that, when, to my great joy, I fell clear out of it, after having been belched up and swallowed down repeatedly by this huge and terrific monster of the air for a space of twenty minutes, which seemed like an age, for I thought my watch had been stopped, till a comparison of it with another afterward proved the contrary. I landed, in the midst of a pouring rain, on the farm of Mr. Goodyear, five miles from Carlisle, in a fallow field, where the dashing rain bespattered me with mud from head to foot, as I stood in my car looking up at the fearful element which had just disgorged me.

The density of this cloud did not appear alike all through it, as I could at times see the balloon very distinctly above me, also, occasionally, pieces of paper and whole newspapers, of which a considerable quantity were blown out of my car. I also noticed a violent convolutionary motion or action of the vapor of the cloud going on, and a promiscuous scattering of the hail and snow, as though it were projected from every point of the compass.

Such is the history of this short but magnificent trip, and I can assure my readers that when I again meet clouds of this character (which I shall name the cloud of terror) I will endeavor with all my skill to avoid them.

When Congress had assembled at Washington, the following petition was submitted to their consideration; and when we take in view the small amount ($15,000) it would have taken to prepare the experimental outfit, backed as it was by competent authority, it seems little encouragement is to be expected from that quarter in any new enterprise, no matter how plausible, unless it carries some partisan force and object calculated to promote aspiring and factious individual interests in some political fortune:

"TO THE CONGRESS OF THE UNITED STATES.

"*To the Honorable, the Senate and House of Representatives of the United States of America in Congress assembled:*

"The petition of the subscriber, citizen of Lancaster, Pa., most respectfully showeth, that, from an experience of a number of years in the practice of aëronautics by the subscriber, it has been fully demonstrated that there exists in the atmosphere a constant current of wind, moving from west to east, with a velocity of from twenty, forty, and even sixty, miles per hour, according to its height from the earth.

"This current is moving in that direction, while the local currents may

be, and are, moving in various other directions. This *eastward* current is governed by a great general cause, blowing at all times, making it feasible to travel the globe in that direction by aërial machinery with great facility.

"Your petitioner would further state that the art of making aëronautic machines has been so far improved that they may be kept afloat for any reasonable length of time, even for years, and as long as a ship can be made to endure the sea for common purposes.

"The main object of your petitioner is to bring into useful requisition, for the purposes of speedy and safe transition of persons and merchandise, that great and unoccupied element, the atmosphere.

"Your petitioner does not pretend to have discovered or solved any great new-fangled problem, but would most earnestly press upon your consideration known facts, which must be explored before any great benefits can be derived therefrom.

"From the improved state to which aëronautic machinery can be brought, and the advantages continually at hand from the local currents of air, it is even now feasible to travel eastward with a velocity that will circumnavigate the globe in from thirty to forty days, and is possible to vary from a straight course thirty or forty degrees from the latitude of departure, which would enable us to leave despatches in Europe and China, and return by way of Oregon Territory to Washington City.

"This has been demonstrated by experiments made by your petitioner, in reaching points sixty and ninety miles distant from the place of departure with a precision not surpassed by ship-sailing, aided by the local currents varying from the great eastward current.

"From these considerations, your petitioner is induced to ask your honorable bodies to make a naval appropriation to carry this project into practical operation, its practicability having already received the confidence of scientific men, and an earnest voluntary offer by several officers of our navy, to accompany the first experimental adventure.

"Your petitioner, therefore, prays you to make an appropriation for an outfit to this effect, viz.: The construction of an aërostat of 100 feet in diameter, of substantial domestic cotton drilling; a sea-boat capable of enduring the ocean, for a car, and so constructed that the masts and rigging may be stowed away, ready for erection into sea-service at any time that emergency *might* require, the sea-boat to be of 10 or 12,000 pounds weight; an aërostat of 100 feet diameter, having an ascending power of over 25,000 pounds, will be sufficient to carry the outfit, ballast and crew.

"Should this meet with your congressional approbation, your petitioner will readily submit a plan in detail, and will cheerfully superintend the construction of the machinery at his own expense, asking nothing more than the command or directorship of the first experimental aërial voyage round the globe.

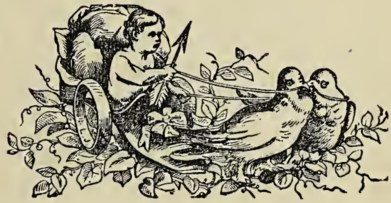
"The whole cost of the experiment will not be more than a fraction of that of the late 'exploring expedition,' and promises, at least, greater results.

"For a favorable decision from your honorable bodies your petitioner feels in duty bound to pray.

"JOHN WISE.

"LANCASTER CITY, Dec. 20, 1843."

This petition was received, read and referred to the Committee on Naval Affairs, where it slept.



# CHAPTER XXII.

Ascent from Hollidaysburg, Pa.—Balloon "Vesperus"—Hollidaysburg papers—Narrative—Difficulty of inflation—Net broke—Ascent—Atmosphere squally a mile up—Net giving away—Fearful apprehensions—Expedient—Descent—Went up again, hanging outside of the car—Dashed into a tree—Escape of balloon—Came down in Catskill Mountains, N. Y.—Alarmed the people—Recovery of balloon, etc.

A NUMBER of voyages were made during the summer of 1843 from Lancaster and York, Pa., Winchester, Va., and the next summer from Fredericksburg, Va., none of which elicited anything remarkably new, extraordinary or different from what has been already related. But the next one, which was made from Hollidaysburg, Pa., is full of interest and instruction. This was made with a balloon composed of a new kind of material—tassore silk, a fabric made by the natives of China from the cocoon of the wild silk-worm, which browses upon the wild mulberry. The "Comet" was sold to Mr. Crever, a pupil of mine, who made several very splendid ascensions with her. The following extracts are taken from the "Beacon Light" and "Register," of Hollidaysburg, which go to show the nature of the preparatory circumstances as viewed by disinterested spectators. The "Beacon Light" said: "The projected enterprise of Mr. Wise, on Saturday (May the 4th, 1844), attracted general attention in Hollidaysburg and its vicinity, and the public expectation was on tiptoe to behold a spectacle sublime in itself, and possessing, in addition, to a large majority of our population, all the charm of entire novelty, no other attempt to visit the upper air ever having been made in these parts.

". . . . . The preparations were made, the basket secured, the intrepid aëronaut took his stand in his frail car of wicker-work, and having received letters for Harrisburg, Lancaster and Philadelphia, and risen nearly to the top of the enclosure with a rope attached, 'cut the connection' with mother Earth, and moved off to the north-east, immediately over the town. The balloon rose slowly until the disposal of a few bags of ballast relieved her of a portion of her burden, when she rose beautifully to a great height, her daring tenant waving his

hat to the crowd below, who, with upturned faces and hats waving, cheered him on his venturous way. After attaining this elevation, the balloon encountered a current of air *flowing to the east,* in which direction it moved off like a thing of life, and in a few minutes was entirely lost to view."

The "Register" had the following: "The ascension of Mr. Wise in his new and beautiful balloon 'Vesperus' took place on Saturday last, according to notice given. The day was entirely too stormy for an undertaking of the kind, and in the opinion of every reasonable man would have justified Mr. Wise in postponing the adventure; but trusting in the excellence of his vessel and his skill as an aëronaut, he determined to make good his appointment and to satisfy every individual of his numerous audience. He accordingly, after a most laborious and oftentimes discouraging effort, succeeded in sufficiently inflating his balloon and getting ready for the voyage, and at the hour appointed cut loose.

"The ascent, although evidently hazardous, from the rupture in the network by which he was attached to the balloon, and from the unsteady and squally state of the atmosphere; was sublime beyond description. When the cord was cut, he rose slowly from the arena, barely clearing the top of the enclosure; and taking a northern direction, he swept across the town, just escaping the house-tops; but discharging a couple of sacks of ballast, he soon mounted high into the aërial regions, to mingle with, as we supposed, the less angry elements above. But in this we were mistaken, for long before the 'Vesperus' was out of sight she was observed to be rocking strangely, as if the elements were no more friendly with her in her elevated position than when bound to earth. The account subjoined, by Mr. Wise, gives a full history of this part of the adventure:

"The ascent of a balloon is a spectacle that to be realized must be witnessed. No description can convey a just idea of its sublimity and beauty, as, like, some creature of life, it smoothly and silently and steadily mounts upward, with its golden sides glittering in the rays of the sun, and its tiny basket and well-arranged cordage swinging gracefully beneath. And then, as the intrepid aëronaut waves his hat at a fearful altitude and sends down a faint response to the loud huzzas below, and every breast heaves deeply with the conflicting emotions of admiration, fear, sympathy and desire for like adventure, a thrill runs through the soul that no description can produce, however true and vivid.

"We need only add here, as the evidence will be given again, that Mr. Wise's conduct on the occasion was highly satisfactory to all concerned, and must greatly increase his reputation as an aëronaut; for we venture to say no other individual ever attempted an ascension under like unfavorable circumstances.

"At about eight o'clock in the evening we heard of his return; and repairing to the U. S. Hotel, we found Mr. Wise, somewhat disheartened about the loss of his balloon, and looking rather worse for the trip, his outer man having suffered considerably from his adventure among the branches of a tree on which he lodged."

## NARRATIVE.

The process of inflation was commenced at eleven o'clock A. M., under very discouraging circumstances, as the elements had combined from all points of the compass to a general and boisterous storm. Nothing, in short, but the most indefatigable energy and perseverance on the part of Mr. Downy and Mr. Woods, who had taken a most important charge under their hands—that of keeping the "Vesperus" to her place—could have enabled me to make an ascension under such a war of the elements. About the commencement of the process of inflation, the reaction of the gas from the balloon, caused by a sudden flaw of wind, blew off the gasometer, which was soon replaced by my energetic friend Mr. Hinkle, and the inflation resumed, but under such discouraging circumstances, owing to the frantic gambolling of the "Vesperus," which made it difficult for the persons who were holding on to it to keep their feet, that I began to fear of their ability to endure the rough usage they were laboring under all the time, sometimes being partly raised up and then dashed to the ground, as by a maddened steed. However, after getting the assurance of these gentlemen that they would hold on, to use their own words, "to the last ribbon," I regained my confidence in my ability to ascend, until I received the heart-sickening information from my friends that the network was fast giving way about the top of the balloon. I now began to give up hope of getting up, and even feared that the balloon would break through her trammels and escape; but Providence sent a gleam of sunshine with a short abatement of the storm, during which time a good supply of gas was worked into the "Vesperus," sufficient for a long voyage.

At precisely three minutes past two o'clock I mounted the car; and having ballasted the vessel while it was restrained by a cord, feeling, as I supposed, the rupture in the network increasing at every surge, it having by this time got so large that a bulb as big as a hogshead was protruding through it, my preparations were speedily completed. Knowing now that time was precious, I cut the rope and gave my friends below a parting salute, which was heartily responded to by a thousand voices.

When afloat, I began to congratulate myself upon the victory that was gained over such formidable obstacles below, and fully believed that the network would stand it safely now, as the balloon was free in the air. She took a northerly direction, ascending rapidly all the while, until an altitude of about a mile was attained, where a violent gale was

encountered, which made the balloon surge off in an easterly direction, swinging the car to and fro, and making the network crack at every surge, which alarmed me about my personal safety. Looking over the edge of my car at the immense depth to the surface of the earth, my heart began to sicken at the idea of falling that huge distance with nothing but the network and car to rely on; and my sensations were rendered still more gloomy by the lowering appearance of the heavens in every direction, as around and beneath the clouds could be seen discharging torrents of rain and wind, with, as I supposed, the moral certainty of the balloon's escaping from the network in a very few more surges. I could see the valleys west of the Allegheny Mountain, on which the sun was shedding its beams of light and life.

I looked up at the balloon, and it appeared to me that the car was receding from it gradually by the giving way of the network, and at this crisis an expedient flashed across my mind—the valve-rope would bear the weight of a hundred pounds, and the top of the balloon was equally strong; my weight was thrown upon it at once. This necessarily opened the valve to its full extent, and brought the machine down to the ground. The velocity of the wind was about fifty or sixty miles per hour, and between this and a rapid descent terra firma was reached about sixteen miles east of Hollidaysburg. As soon as practicable, an anchor was thrown out, which grappled in a fence and capsized it, when the machine bounded across the field, where it caught in the next fence, but broke it, carrying with it a fence rail, causing the car to bound and rebound from the earth, and dashing headlong into a very rugged piece of mountain woodland. At this juncture I clasped several of the net-cords in my one arm and made a spring overboard for a fence that was intercepting my path, and, unfortunately for me, at the same moment the rail was loosened from the anchor, when the balloon rose with a bound—my body outside of the car, one foot in the rigging, and my arm clasping several of the net-cords. My right hand was still free, and with it I quickly grasped the valve-rope, which had been tied to the rim of the car, and secured it in my teeth, holding the valve open, when in another moment I found myself dashed into the top of a high tree, where I quickly grasped the limbs, still clasping the cords in my left arm. This brought the balloon to for a moment, when with my right hand a hitch round one of the limbs was taken with the anchor-rope. Then followed a squall of wind which warned me to release my arm-hold of the cords. One foot was in the car, and, to my utmost dismay, I found it tangled in the rigging. There I was, holding on to the top of the tree with a death-grip, head down and feet up, the balloon surging and drawing the top of the tree, which I was holding to, in the direction of the squall, which only abated momentarily for a more violent surge. I could no longer keep the valve open with my teeth, the rope had become too long, and I could not take a shorter hold, in

the dilemma, without incurring another risk—that of letting one hand loose from the tree-top. But things were growing desperate, and I made a violent but successful effort to loose my foot, at the same time grasping the valve-rope in my hand, and in another moment a terrible crash indicated that the balloon was off, having broken the anchor-rope and jerked through my hand the valve-cord, burning it as though a hot wire had passed through it, and I left hanging in the top forks of the tree where I had fallen.

As soon as I had recovered a reasoning position, I looked upward, and just saw the balloon dashing furiously off and upward into a dense black cloud, some distance to the north-east. In referring to my machinery I found that I had taken unnecessary alarm. The cracking noise of the network must have arisen from the surging motion of the balloon, for the network had gone through double the force since landing, and not been torn off yet, proving that it was all-sufficient to have borne its load to its destination, which greatly enhanced my chagrin, since the wind and weather were so favorable for reaching Philadelphia before dark. I began to reproach myself with unnecessary fear, until I saw my hat, map, newspapers, canvas, handkerchief, etc., scattered about below, when I began to think it might have been worse, though I should never see the "Vesperus" again.

After soliloquizing in the tree-top a while upon the day's adventure, I thought it time to come down, for I was near a hundred feet from the ground, and accordingly descended, leaving part of the anchor-rope dangling in its top, as a signal for the next aërial traveller who may chance to land there.

Within a few weeks afterward I learned that the "Vesperus" had landed, the same day of her departure from Hollidaysburg, at half-past six o'clock, on Mr. Van Valkenberg's field in the Catskill Mountains, in the State of New York. I repaired thither, and recovered the balloon. The persons in the neighborhood were much astonished at its arrival, and it was under considerable apprehension they were induced to examine it. Mr. Van Valkenberg's son was out in the field ploughing round the hemlock stumps when the balloon was coming down, and upon seeing it in the air thought it was an immense bird of prey pouncing down upon him, which alarmed him to such a degree that after he had fled to the house he was affected with violent spasms. The balloon was suffered to roll and toss about the hemlock stumps for some time before it was secured. The next wonder to the persons that secured it was the newspapers that had remained in the car, they bearing the date of the day on which they found it, and Hollidaysburg was a place they knew nothing of until they looked over their geographies, and then its being several hundred miles off over the mountains and rivers puzzled them still more. The balloon was cut in six sections when I got it, Mr. Van Valkenberg informing me that an individual who had come along that

way, and who professed to be well informed in such matters, cut it up in that manner for them. The shrubbery which had been twined around the car before it started had turned entirely black, showing that it had been in a high, frosty atmosphere. The balloon had no doubt burst, owing to the expansion of the gas, which caused it to come down so soon.

Before I took it away, all these wonderments of the people were explained to them, and they expressed a great desire to have an exhibition of such a novel kind in their neighborhood. This machine was fixed up again; and after making a number of trips with it, two from the city of Columbia, in South Carolina, I sold it to a gentleman of that State.

## CHAPTER XXIII.

Ascent from West Chester, Pa.—Extracts from aërial log-book—Descent in a thunder-storm—Car struck with lightning—Alarm of it—No serious consequences—Another ascent from West Chester—Next ascent was made from Utica, N. Y.—First ever made from that city—Another from Utica—Project of war-balloon to reduce the castle of San Juan de Ulloa at Vera Cruz—Offer to government—Comments on it—Letter to the War Department concerning it.

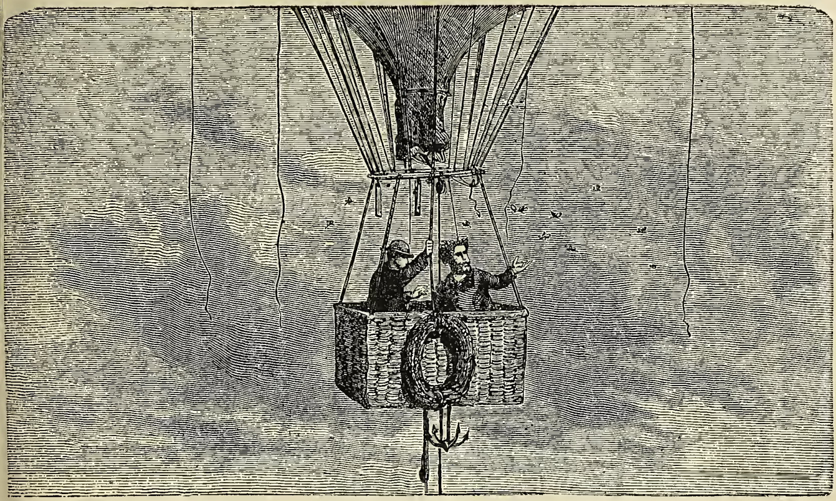
A NUMBER of ascensions were made which will be passed over silently, on account of their not comprising any features that would sufficiently vary from those already recounted. The next one worthy of note was made from West Chester, Pa., August 8, 1846, in the balloon "Rough and Ready." On this occasion it was my intention to sail as near the surface of the earth as practicable with a balloon of limited size, and the log-book of the voyage will show how far I succeeded in that respect. A balloon of twenty-one feet diameter is very liable to fluctuate in height, compared to that which a fifty or hundred feet diameter one would be. There also occurred an electrical discharge at the end of this voyage that is worthy of note.

The following extracts from my log-book were published in one of the West Chester newspapers:

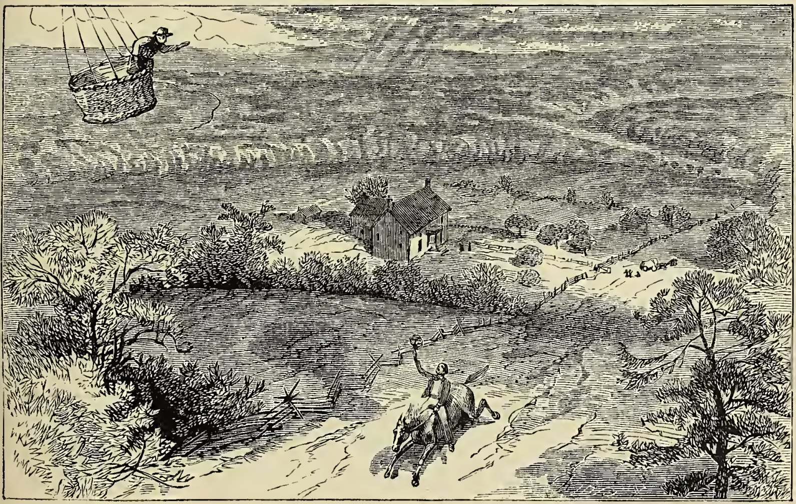
"Four o'clock fifteen minutes, started with a southerly breeze, at the rate of twenty-five miles per hour.

"Four o'clock twenty minutes, atmosphere to the south and east perfectly clear. Can see Philadelphia as distinctly now as it has been seen at other times when not more than three miles off. The rain in that direction has cleared the atmosphere. See some sails on the Delaware; sun shining against them gives them a golden hue; vessels as distinct to my view as though I were on the river bank. Four o'clock thirty-five minutes, rumbling thunder to the far north. Four o'clock forty-five minutes, crossed Pennsylvania railroad."

[It may be here observed that the balloon was sailing toward the north-east, and a thunder-gust was moving from the north-west, about fifty or sixty miles to the north-west of me, thus moving at right angles with each other, and the remarkable result of the balloon meeting the storm at the point of intersection made the ascension one of great interest.]



BUZZ-FLIES ABOVE THE CLOUDS.



"THE RACE WAS BEAUTIFUL AND EXCITING."

"Five o'clock, lost sight of West Chester. Came down now within good speaking distance of the earth, and so low that the Delaware vanished from view. Thunder pealing louder now, but no lightning perceptible. Talking to the people below as I passed along. Dogs barking at the balloon, and poultry dismayed in the barn-yards, keeping an alarming clatter. Distributing newspapers to persons below, who run and pick them up. Balloon moving rapidly. A man on horseback in hot pursuit. 'Come on, come on! I'll give you the latest news from West Chester.' Several papers were dropped now. There! he grasps at one from his horse. 'Have you got it?' '*Yes, sir.*' 'Good-bye, sir,' said I. '*Come down,*' says he.

"Five o'clock ten minutes, crossed Schuylkill above Norristown—threw out ballast, and ascended very high. Can see all around to a great distance. Phœnixville a little up the river. Going too much east to reach Reading. Came down again to within good speaking distance of the earth.

"Five o'clock twenty minutes, near the Trappe, and over the Reading and Philadelphia pike. Invitations from all around me to 'come down;' threw over some newspapers to the people; inquired if I could get supper there. 'Yes, anything you want.' To cap the climax, one of them sang out, '*Come down, and I will give you a bottle of brandy.*' 'Thank you, sir; *spirited* enough; I believe I'll go a little farther.'

"Five o'clock thirty-five minutes, thunder-gust approaching the track of the balloon. Low enough to hear the wind rustling in the trees. A great many persons following the balloon. Some give up the chase; others strike in with fresh vigor.

"Five o'clock forty-five minutes, moving parallel with the Norristown and Germantown road. Storm and balloon converging to the same point; vivid flashes of lightning were now occasionally to be seen in the north.

"Five o'clock fifty-five minutes, a man on horseback in hot pursuit up the road; horse's head and tail in a straight line. The race is beautiful and exciting; he is losing ground every jump; now he holds up a mile behind.

"Six o'clock, and moving over a thick wood."

Here I ceased taking notes; the car was near the tree-tops; thick woods underneath, and a roaring thunder-storm just ahead. Already its commotion was acting on the balloon, and it would not do to seek shelter among the trees below, and yet the alternative was to do that or sail right into the teeth of the storm, for there was not ballast enough left to *ensure* an ascent above it before getting into its midst. Indeed, it required all my ballast to keep above the tree-tops until the woods were passed, and this brought me right into the thunder-gust. A number of persons followed me from the woods afoot, but they could not keep pace with the balloon, and lingered behind at least three quarters of a mile.

As soon as a clear spot was attained, the anchor was thrown out, and the moment it struck the ground a vivid flash of lightning hurled the balloon against a tall oak tree. What appeared to me remarkable in this was the absence of a report, but the fire flashed from my car and flag, the latter hurled out of the basket where it had been stuck in the wicker-work. This flash reminded me of the sparks that fly off from a piece of white-hot iron just taken from the forge to the anvil, and struck with the hammer; and the noise was like that made by a hammer also. Just at this moment, a young man was running to my assistance, intending to catch hold of a drag-rope which I had thrown out and requested him to take and make a hitch to a tree with. But the flash brought him up suddenly, and made him stand aghast and immediately retire. The balloon was now tangled in the oak tree, and the smoke I had observed at the time of the flash, which, with the sulphurous smell, had alarmed me, was the gas issuing from the breaks it received against the scraggy branches of the tree. Fortunate it was that there was no escape of gas at the time of the electrical flash, or an explosion might and would, in all probability, have been the result.

The persons who had followed me from the woods now came up; and before we could roll up the balloon, the gas having escaped readily from the breaches in it, we were enveloped in a terrible storm of thunder, lightning and pouring rain.

When I returned to West Chester, arrangements were made for another ascension from that place, on the 24th of the same month, but nothing of importance was elicited during its progress.

In the beginning of the following September I made an ascension from the city of Utica, in the State of New York, having received an invitation from there. It was a success, and in about two weeks, in response to an urgent invitation, I made another one, which went off in an equally satisfactory manner.

Our government being then at war with the Mexican nation, and the hostility between the two countries growing stronger every day, it was determined by our War Department that the formidable castle of San Juan de Ulloa should be reduced. Various projects being under consideration at Washington for the acomplishment of this end, I thought it proper to submit the following to our government:

"EASY METHOD OF CAPTURING THE CASTLE OF VERA CRUZ.

"The present condition of the war with Mexico will require our forces to reduce Vera Cruz. It is acknowledged on all sides to be an extraordinarily well fortified point of defence, almost impregnable to the common mode of warfare, and at best cannot be taken in that way without a great sacrifice of life and ammunition. I will, therefore, suggest a plan to our War Department which will render the capture of the castle of San Juan de Ulloa as easy as the launching of a frigate.

"A VIVID FLASH OF LIGHTNING HURLED THE BALLOON AGAINST A TALL OAK TREE."

"Although the plan I shall propose may seem novel to many, still, a brief detail of it, I think, will satisfy the most incredulous of its efficiency. In the first place, it will require a balloon of common twilled muslin, of about a hundred feet in diameter. This machine, properly coated with varnish, will retain its buoyancy for many days or weeks. It will be able, when inflated, to raise over 30,000 pounds—say 20,000 independent of its own weight, network, car and cable. It can be inflated in a day, or less time if necessary. The process of inflation may be accomplished on land or on board a man-of-war at sea, as circumstances may require. The car to be laden with percussion bomb-shells and torpedoes to the amount of 18,000 pounds, which will leave two thousand pounds for ballast and men. Thus it will be ready to be placed in a position for deadly action in a very short time. The cable by which it is to be manœuvred may be at least five miles long, so that the balloon at a mile of elevation would leave the vessel or land position which would act as the retaining point out of the reach of the castle guns, and under the cover of our own batteries. The man-of-war balloon, hovering a mile above the castle like a cloud of destruction, would be entirely out of danger of the enemy's guns, since they could not be made to bear on an object immediately above them. The position of the balloon as to height and distance from the retaining point could be maintained by keeping a proper eye to its ballasting. As it would become lightened by the discharging of shells and torpedoes, an adequate quantity of gas could also be discharged.

"If a gun from the castle could be ever made to bear upon the war-balloon, it would soon be silenced by the rapidity, precision and certainty with which the deadly missiles could be showered down upon it.

"With this aërial war-ship hanging a mile above the fort, supplied with a thousand percussion bomb-shells, the castle of Vera-Cruz could be taken without the loss of a single life to our army, and at an expense that would be comparatively nothing to what it will be to take it by the common mode of attack.

"I would most respectfully suggest this plan to our government, and will tender my services for its construction, and when constructed will, if necessary, most cheerfully undertake its directorship into actual service, at a moment's warning.

"Respectfully,
"JOHN WISE.

"LANCASTER, Oct. 22, 1846."

The proposition drew out a great many opinions and commentaries upon the plan, one of which we will state, taken from the "Philadelphia Public Ledger:" "The public have been amused by the many comments upon Mr. Wise's plan of taking San Juan de Ulloa. His idea is to laden balloons with men and explosive bombs, raise them over the devoted

castle, and let the bombs fall upon it and blow up by concussion. This new method of besieging a fortress has been discussed in every vein of seriousness, wit or contumely, as the idea seemed feasible, funny or absurd to various minds. At a recent party in Frankfort, Ky., the subject became a topic of conversation. After a number of persons had said their say, pro and con, a distinguished wit, an ex-governor of the State, was called upon for his views touching the same. With great dignity he pronounced the plan an admirable one, and the inventor a man of military genius; but he added, 'I think it will be a very troublesome matter to enlist volunteers for that service.'"

Soon after this the following note was addressed to the War Department:

"LANCASTER, December 10, 1846.

"EX-GOVERNOR MARCY, Secretary of War of the United States:

"SIR: You have no doubt seen and perhaps somewhat considered over the plan and proposition I suggested through the public prints for the reduction of the castle of San Juan de Ulloa by balloon. Were it not for the incredulity and prejudice that invariably meet new ideas and projects, I should from the commencement have submitted it to the War Department for scrutiny. But believing that it would best be tested by 'public opinion' in bringing out serious objections to its feasibility, I chose the course of having it first analyzed in the popular crucible. By this course I would be enabled to discover what in my first conceptions of the plan might have been overlooked, and thereby save myself the trouble of further urging its merits toward action, as also any formal application for its consideration by the War Department.

"So far from any well-founded objections having as yet been urged against its practicableness, I find some of the best minds in the country in favor of the project. And upon a mature and deliberate review of the whole subject in its minutest details, I write to you with a most unwavering conviction of not only its practicability, but my ability to give it the desired effect. It will be unnecessary at present for me to enter into any detailed account of the necessary requisites to its consummation, but I will state that the cost of outfit, independent of the war projectiles, would be but a trifling matter compared with the magnitude of the work it would be capable of accomplishing. As to the objections that may or can be urged against its feasibility, I am ready to rebut them with mathematical and philosophical demonstrations. Should the War Department desire to have further explanations of its character, or have any objections to its practicability refuted, I will gladly confer with it upon the first intimation of such a desire. The novelty or chimericalness of its character will, I trust, have but little weight upon the minds of the intellects composing our government in

deterring them from a fair and impartial scrutiny of a subject so pregnant with national welfare.

"It has been hinted that it would be difficult to get men who would act in such an enterprise. This belief is as unfounded as any other I have yet heard urged against it. It would require but nine assistants in the bomb-car, and that number I will guarantee to secure from my own city.

"With an earnest solicitude for the early consideration of my plan, I remain your fellow-citizen,

"JOHN WISE."

The War Department, however, was not sufficiently advanced in its ideas to give the proposition the consideration it deserved, and like many other good suggestions it came to nothing.

# CHAPTER XXIV.

Career of 1847—Philosophers should go up with balloons—Earth's attraction—Ballooning only ahead of the age—Letter from Professor Henry, secretary of "Smithsonian Institution"—Hollowness of the globe demonstrable by the laws of atmospheric pressure—Matter and its laws—Another ascent from Utica—Next from Syracuse, N. Y.—Narrative of it.

IN the summer of 1847 I commenced the season's ballooning campaign in the city of Lancaster. Having sold the old "Rough and Ready" to Mr. Smith, of Utica, a gentleman of high scientific attainments, a new one was made during the winter, which also was named "Rough and Ready." The first ascension with this new balloon was made on June 7th, and the following are extracts from the notes made:

"I will not on this occasion rehearse the beauties of the Conestoga valley, but merely state that I am justified in assuming that the sight of such magnificent scenery and the natural inspiration of the observer arising from a combination of causes while sailing through the ethereal heaven over such a specially blessed land must cause him to approximate to a state of celestial bliss.

"It seems to me remarkable that a subject which is theoretically so well understood and so practically safe as is ballooning, and which holds out such extraordinary inducements to the scientific world, and such grand mental exaltations and developments of nature's poetry, should be so sparingly enjoyed by the philosopher and poet.

"Now, whatever may be the force and condition of the earth's attraction near any part of the surface, I find that at the height of a mile or two from it light bodies show a remarkably diminished degree of attraction of gravitation. From a series of experiments made with sand, pith-balls, slips of paper and ribbons, it seems that the balloon and its appendages attracted them more than the earth did when they came in close proximity to any part of the machine, or, I might say, when within its individual atmosphere. Frequently, the ribbon or slip of paper, as the case happened to be, would vibrate between the car and the body of the balloon, falling up and down agreeably to the jarrings and motions incident to it. Whether this is attributable to the power of the balloon's attraction, from its being at the time a perfectly isolated

body, or from a diminution of gravitation according to the distance from the earth, I had not at the time the means of testing. On a future occasion I will test it with a delicate spring balance, in weighing a body at the earth's surface, and weighing it again at a great height. If the earth is hollow, as the economy of nature indicates it to be, and the law of gravitation arises from the *actual weight or quantity of matter*, a height of three miles from the earth would, no doubt, show an appreciable difference in the weight of bodies. There is a connection between an inflated and duly ballasted balloon and the earth so extraordinary, as I have for a long time observed, which makes me think that the law of attraction of gravitation is governed by the *actual weight* of bodies, and not by their surfaces. This has been indicated to me in the practice of ballooning too strongly to go unobserved; and yet there are so many causes affecting the position of a balloon when near the earth that I would rather seek its solution by the actual trial of weighing a given body at the two remotest attainable points than to depend on hypothetical statics alone, which do not sufficiently explain this phenomenon of a balloon's *labor* when near the surface of the earth.

"There are so many influencing causes to be taken into consideration in connection with the effects here mentioned that nothing short of repeatedly-varied experiments will be sufficient to determine definite conclusions. We have now systems and sciences connected with this subject which are based so much on hypothesis alone that we should be very cautious in conclusions based upon experiments, whether they may or may not be fully corroborative of received theories.

"In concluding this account, I would remark that ballooning is about half a century ahead of the age; but if the spirit of mechanical progress, necessarily requisite to a high attainment of scientific principles, keeps pace with the onward march of intellect, *our children will travel to any part of the globe without the inconvenience of smoke, sparks and sea-sickness, and at the rate of one hundred miles per hour.*"

While on the subject of attraction of gravitation, it will not be out of place here to state that I addressed a letter to Professor Joseph Henry on that question, and also regarding the atmospherical currents, and here is the reply:

## LETTER FROM PROFESSOR HENRY.

"Smithsonian Institution, May 8, 1849.

"My Dear Sir:

"The inquiry with regard to the hollowness of the interior of the earth could not be solved by any variation of gravity above the exterior surface, for it can be mathematically demonstrated that the attraction of a solid globe and also of a hollow sphere are the same as if all the matter of each were concentrated in its centre. The law of diminution of gravitation, as measured above the earth, would be the same in

both cases. A spring balance, if sufficiently delicate, would indicate a difference in the weight of a body suspended from it at different elevations. But this, as I have said before, would give no information as to the hollowness of the earth.

"I have no doubt that there are great currents in the upper regions of the atmosphere, and particularly the return currents of the trade-winds, which should blow continually from south-west to north-east. Should you conclude to make another aërial voyage, I should be pleased to suggest some observations.

"Very respectfully, your obedient servant,

"JOSEPH HENRY,

"*Secretary to Smithsonian Institution.*

"John Wise, Esq."

It is proper to state that I made the particular inquiry of Professor Henry whether there was a difference between the laws of electrical attraction and attraction of gravitation, as laid down in received hypothetical science. My own hypothesis is that, as the atmosphere finds its minimum density at about forty-five miles above the surface of the earth, it must necessarily find its maximum density forty-five miles under the surface of the earth, which, according to the law of atmospheric pressure, would bring the air to about the density of water, at that depth below the earth's outer surface which I presumed to be the thickness of its crust or shell. According to this law of atmospheric density, and the equally well-known law of water's slowly-increasing density at great depths—that is, its compressibility—these two elements could not exist as different or distinct bodies forty-five miles below the earth's surface, but must mingle into one body, or one mass, from their equal densities or specific gravities, and their equally well-established fluidities; and, therefore, the relation of distinction in these substances, so important on the earth's surface, must there cease, and the reasonable presumption follow that a new order of things exists from this point inward. From these established laws of pressure and density, and the fact that water and air are found in the depths of the earth, and the reasonable hypothesis of the earth's hollowness, and its inner cavity being necessarily filled with an atmosphere or fluid of some kind as dense as water, many of the phenomena which we now only know by their actual existence may be solved by these laws and principles; particularly those of tides, spouting springs, aurora-borealis and volcanic eruptions.

In following out these inductive reasonings, I perceived that the weight of the earth would not be much, if any, less, by being hollow, than if it were composed of clay, rock and water all through, which, however, cannot be the case under the known law of atmospheric pressure and density, as, at the very moderate depth of fifty or sixty miles under the

earth's surface, air would be vastly denser and heavier than water, clay or rock. Therefore, whether we assume the earth to be hollow or solid all through, judging from matter and its laws as existing, there could be no proof of the certainty of the one or the other by the test of weighing a body at the points mentioned with a delicate spring balance.

Pursuing the investigation of matter, and its conditions under the well-known laws which govern it, we cannot conclude that at the outer borders of our atmosphere a vacuum commences, but we must rationally conclude that there is a new order of matter, different from a merely highly rarefied condition of air. Caloric, or what we know by imponderable matter, may at that point assume a character of substantiality sufficiently dense to keep the earth afloat in it. An atmosphere of high-pressure steam seems to be nothing more than water minutely divided and highly charged with calorific atoms—a condition which may be inductively attributed to the medium existing between the planets, and which commences where our atmosphere ceases to exist.

Having in the beginning of this work stated that meteorology should not pass unnoticed, the remarks just made concerning the internal condition of the earth, having naturally grown out of it, will not be considered impertinent to the subject.

During the summer of '47 a third ascension was made from Utica on the 5th of July, in which a distance of five miles was made before the descent.

The next trip was made from Syracuse, N. Y., July 17th. Part of the journal will be quoted:

"Onondaga Lake looked like a tiny fish-pond, and the salt sheds around the north-western part of the town had the appearance of so many market-houses strung in parallel rows at different places. Salina, Geddes and Liverpool looked like elongations of the Vena Porta of Syracuse. To the east of me, and apparently not far off, lay two considerable villages, which I cannot name. The great Erie Canal also seemed awakened to the scene of the day; the numberless craft on its water stopped to see the balloon, and the crews sent loud and repeated cheers for miles each way. The town appeared like a perfect bee-hive, and the arena, graced with a tremendous throng—yes, a tremendous throng—of Onondaga's fair daughters, had all the appearance, when looked upon from so great a height, of one of Aladdin's enchanted scenes. All nature sang in one harmonious strain of music; softly and sweetly faded the shouts, the murmurs, the æolian-like concert of nature's revelry upon my ear, as the last boundary of hearing was passing by.

"And now I was far away—far above the sphere of human observation; no sounds, no cheering, longer greeted my ear; the fair town of Syracuse, like her ancient prototype, was fast fading away in the distant mist; Nature, with her sweetened voice and fairy green, was dying away in the

evanescent vapor of a doubtful reality; the cold, chilly atmosphere of a two miles' height made me shudder involuntarily; in spite of all my efforts to the contrary, my teeth chattered with all the fervor of a cold ague. How changed! In a few moments, from the arena of nature's most gorgeous scenery, I was transferred, as it were, into the icy chamber of death. Oneida Lake appeared to be gaping eagerly to receive me in its cold embrace.

"Suddenly I awoke from my revery; I looked around once more, above, below, to earth; I caught hold of the valve-rope; soon the vapor was shooting upward by me; I was falling rapidly into a more congenial climate, and in a few moments more was down in a hemlock clearing, tearing up fences, limbs of trees, etc., until the grapple-iron finally took substantial effect in a hemlock stump about six miles from Syracuse."

## CHAPTER XXV.

Ascent from Auburn, N. Y.—Narrative of its extraordinary magnificence and grandeur—Ascent from Buffalo City, N. Y.—Windy weather—View of Niagara Falls from balloon—Disappointment of expectations—Looked like a frothy bubble—Another ascent from Buffalo—Driven out on Lake Erie—Rescued by brig "Eureka," Captain Burnell—Ascents from Rochester—Oswego.

ON the 24th of July, 1847, I made an ascension from Auburn, a flourishing and beautiful town situated about twenty-five miles west and a little south of Syracuse, making it a favorable point to reach Syracuse from by the upper current which always blows from west to east. It was a magnificent voyage, and the main part of the journal is worth a perusal here, to wit:

"Up, up I soared, almost perpendicularly, until an altitude of at least a mile and a half was reached, when I began to look around me, and then, great God!—yes, I made the exclamation again as I was sitting with my pencil and log-book in hand riveted to the sight—great God! what a scene of grandeur! Oft have I enjoyed and revelled in the intellectual indulgences of nature's luxuries. Many, many beautiful and magnificent scenes have I witnessed, but this surpasses all. Such were my involuntary exclamations. I looked around again and again; still, the reality seemed like a splendid dream—an enchantment; it was too rich a scene to be deprived of by a short trip. After I had viewed and reviewed the vast panoramic plain, and wondered at and admired the handiwork of the Creator, its amplitude and order, I would try and settle my mind down to a cool and descriptive standard, but admiration and amazement had enchained my thoughts alone for nearly one hour, and ejaculations flowed over the glorious spectacle beneath me. The vastness of the scene, extending nearly a hundred miles each way (the atmosphere was very transparent), beautifully interspersed with lakes; the innumerable villages, many of them glittering with silvery domes and spires; the tiny and tastefully decorated prison-house at Auburn; the thousands of variegated grass-plats; the golden tinge of the waving grain-fields; the

glossy surfaces of the lakes dazzling in the sunbeams; the lights and shadows over the general surface caused by a partly clouded sky; the huge precipices of clouds lying to the east and partly beneath me; the wide mirror-like surface of Lake Ontario, with its fringed southern border; the cities in the evanescent distance decorated with brilliant specks, with a thousand other things, so completely absorbed my mind that when I looked at my watch I found that I had been aloft one hour and ten minutes.

"Looking up at the balloon, I found her discharging gas at the safety-valve. Although but half filled when she left the garden at Auburn, the immense machine was now full and distended to the utmost tension, showing that my altitude was over two miles. A cluster of detached clouds was hanging between me and Syracuse some distance off. Here I took another observation of the lakes, and counted thirteen in view; Lake Ontario looked like an immense sea, its northern boundary lost in the distant heavens. After being aloft one hour and a half, I found myself crossing Onondaga Lake, having northed too much for Syracuse, and making direct for Liverpool, a village five or six miles above the latter place, near which I made a landing, breaking the Oswego telegraph wires with the grappling iron."

The following is from the log-book kept on this my sixty-second voyage:

"Buffalo City, Morris' Garden, July 31, 1847.

"Four P. M. precisely, started with aërial ship 'Rough and Ready' under ballast and brisk gale from the S. S. W., wind moving at the rate of a mile per minute. Started with considerable ascending power, but the current was so strong that in order to make a more perpendicular rise thirty pounds of ballast was thrown overboard, which lightened the vessel. A strong gale blowing against it as it rose caused it to pitch and gyrate with a desperate motion, which turned the balloon about one-third round in the network and made the valve partly unmanageable.

"My first observation was of the place I had left, and was made five minutes afterward. The city, although covering much territory, seemed compressed into an area of a hundred yards square. Lake Erie appeared tapered off to a narrow, ragged pond on its eastern extremity; then it diverged into two narrow, silvery threads, which reunited again around a small green plat. Upon reflection, I concluded this must be Grand Island, and immediately my attention was drawn to a search for Niagara Falls, as I heard a slightly rushing noise of a waterfall. My eye soon rested upon it, and after scanning it for a few moments I involuntarily cried out, 'Is that the falls?' And no wonder I was surprised, for it looked like a cascade such as we see in pleasure gardens. I was disappointed, for my mind had been bent upon a soliloquy on Niagara's raging grandeur, but it was a bubble; it looked too small.

"The scenery of the great panorama surrounding it could only absorb

my mind. The little frothy bubble had too much the appearance of a foaming glass of London brown-stout, and it was insufficient of itself to excite an idea beyond that. It looks like a little humbug when viewed from the clouds. The scenery around it was not so pleasing as that presented around Auburn, Syracuse and Utica. Here the country appeared dry when viewed away from Lake Erie. A vast plain well wooded, with few roads and less villages; it was altogether of a barren cast.

"I made a landing at Williamsville, and was within a few feet of grappling into their church steeple, which might have caused serious consequences at the rate the balloon was moving had it caught into it. This is distant from Buffalo twelve miles."

A week after this another ascension was made from Buffalo. I give the following extracts from my log-book:

"BUFFALO CITY, August 6, 1847.

"Left Morris' Garden at precisely six minutes past four o'clock with the aërial ship 'Rough and Ready.' Wind from the north, balloon rising slowly. Threw over some ballast; men, women and children scrambling out of the way. Ascent became more rapid. Rising and moving along parallel with Main street—a little east of it. As I rose, the current bore for the lake; began to feel chilly upon the thoughts of a ducking. One mile out on the lake threw out more ballast to reach the great eastward current. Got up a mile, and struck a current at the rate of twenty miles per hour up the lake. This won't do; I shall get out ten or twelve miles before I can reach it, and then probably be blown into Canada, where I would stand a chance of arrest for *contraband.* Opened valve and came down within speaking distance, just over a brig going into Buffalo. 'Ahoy! what vessel?' 'Brig Eureka, Captain Burnell.' 'Will you lower a boat, captain, if I come down?' 'Certainly, sir,' answered Captain Burnell. 'Then I'll be down presently.' Came down with all despatch; the brig laid to, but I got astern of her several miles before her boat was lowered, and by that time my car struck the water.

"The balloon first rebounded and glanced over the water in a ricochet manner, until sufficient gas was discharged to sink the car some depth in the water. This retarded its progress up the lake, and I found the yawl sent from the brig was gaining on me. In a half hour longer the boat was alongside and took me in tow. The gas was soon all discharged, and in another half hour I was safely aboard of the brig Eureka, in company with the generous Captain Burnell, who took me into port that evening."

Ascensions were made from Rochester and Oswego, N. Y., the same summer; both of these trips were of short duration, owing to the prox-

imity of the lakes. In the account of the one from Rochester the following in relation to sounds occurs:

"There is but one point of peculiarity in the circumstances of my voyage made on Saturday, the 14th of August, which is worthy of particular notice. I have always noticed that certain sounds, produced at the surface of the earth, have a remarkably peculiar effect upon the ear of the aëronaut when immediately over them. Waterfalls are of this kind in their noise. Even a common mill-dam produces a wonderful noise to one's ears when a mile above it. The Genesee Falls made a noise to my ears when above them over a mile an hundred times louder than did Niagara when I stood upon its brink.

"I noticed the same peculiarity particularly in the returning echo of my own voice when over Lake Erie. There the sounds of voice from the persons on board the brig Eureka were remarkably clear and distinct to my ears when immediately over them, but still not so much so as was the echo sound of my own words. This appeared even louder than the original utterance, and the enunciation quite as distinct. In the case of the words spoken from the brig, they became fainter and very indistinct after I got at an angular position from them. From this it appears that the occasional sounds which greet my ears so distinctly when sailing along at great heights must arise at points immediately underneath me. The same peculiarity holds good in vision. Immediately below one objects appear very distinct, but very diminished from their real size, while at a great angular distance they appear diffused."

In my voyage from Auburn there appeared a very striking phenomenon regarding vision. I noticed in the account of it the lucidness of the atmosphere. But there appeared also a *looming* up of objects in the distance. Lake Erie, which was over a hundred miles off, seemed elevated ten or twelve degrees above the horizon, and yet composed part of the visible horizon.

Sound and vision are propagated distinctly in perpendicular lines from the earth's surface; when heard and viewed in angular directions, the resulting effects are diffused in both cases. This I have also noticed in the music when ascending. The tune played by a band of music as I ascended perpendicularly above them was distinct and clear; and when moving off in a rapid horizontal direction, it became very diffuse at a short distance. The firing of cannon, when it is done immediately underneath the balloon, agitates it violently, often with considerable depression in its lower side; but when the firing is at an angular distance, though much nearer than the perpendicular position just mentioned, it is not near so perceptible.

## CHAPTER XXVI.

Reminiscences of the early days of ballooning in America—A trip to New Jersey —A Fourth of July salute—Descent into a peach orchard—Terror and wrath of the proprietor—The balloon fast to a wagon—Rescue of the aëronaut.

WE find chronicled in the early history of American aëronautics many strange and startling accounts of balloon adventures—stories of tangled valve-ropes and disarrangement of the network; statements that these incidents caused the daring aëronauts to clamber up on the outside of their air-bubbles to fix aright these disordered contrivances, in disregard of the laws of gravitation, which in many cases would have kept them on the under side of the balloon, unless it had an exception to its rule. Some gave accounts of hardships and sufferings equal to those of the shipwrecked mariner on his sea-tossed raft. They said that the great heights attained caused the blood to ooze from their finger-ends, and in some instances that their fingers were frozen off. There were various other extravagant stories almost equalling the narrative of Sinbad the sailor. While the very nature of this mode of sailing made it appear marvellous to the ordinary reader, it was an easy matter to intensify the natural romance into that of fiction of the loftiest kind, founded so slightly upon fact as to leave but little doubt in the mind of the educated that these high-flying gentry were fond of drawing the long bow.

These sensational stories made many people imagine that ascending in a balloon is as foolhardy an adventure as going to sea in a tub. As time grew apace, so did the art of aëronautics become better understood, and now, near the hundredth birthday of our independence, and the ninety-first of the balloon, none but a few of the masses of the people, and fewer still of the learned classes, always excepting the ingrained fogies, look upon the science, in the hands of trained persons, as any more fraught with danger than that of sea-sailing.

True enough there were many ludicrous adventures in the practice of ballooning in the old time, as very few people in the rural districts knew what a balloon was, and to see a great bladder-shaped thing, with something dangling at its tail-end, hovering like a demon of the air

over their heads, and sometimes coming down upon them with grappling-irons, was enough to excite a feeling of alarm in the minds of unsophisticated people.

At that early period the practice of ballooning was full of peril to the aëronaut in case of his failure to ascend at the appointed time, no matter what might have been the cause of the disappointment. No excuse was sufficient to shield him from the displeasure of the congregation of people brought together by exhibitions of this kind. Up he must go, or be mobbed, and his aërial rigging be subjected to ignominious destruction. The old Vauxhall garden mansion on Broad street, in Philadelphia, was the scene of one of such riots upon the failure years ago of a French aëronaut to ascend with his balloon. The enclosure was torn down, the buildings burned to the ground, and the silken balloon was trailed through the streets in triumph by the mob. At a later period, and at the time the writer was constructing his first balloon, another of these riotous proceedings took place in Camden, New Jersey, because the unfortunate aëronaut failed to generate a sufficient amount of gas to lift him up. In this instance the damage consisted of breaking down his enclosure and tearing up his balloon.

Time, and with it a better understanding of the nature and difficulties of balloon experiments, somewhat assuaged the spirit of violently disposed spectators. Nevertheless, now and then an unlucky professor of the aërial art would find himself in the hands of the sheriff; and instead of resting in the bosom of a summer cloud, he would be marched off to the county jail, as much for his protection as to conciliate the exasperated individual who raised the riot. This feature in the introduction of aëronautics in the United States indicated a singular mixture of civilization and barbarism in the mass of the people that is now happily done away with by our system of general education and a better knowledge of scientific projects.

A number of years ago some of my friends in Philadelphia determined to have a private balloon ascension for the especial benefit of their families, undisturbed by the annoyance of the crowds which always assemble upon public occasions of this kind. Accordingly, the expedition was arranged, and it took place from an enclosed lot at Ninth and Green streets. Two Indian chiefs were present who a year before had seen me in a balloon ascension, which was made for the edification of a delegation of Sacs and Foxes under the charge of John S. Cash, Esq., Indian agent.

The day was fine, and all the company, especially the ladies and the young folks, were delighted with the swelling and puffing incident to the inflation of the balloon. This completed, the panting air-craft, with its occupant, was soon on the way to New Jersey, where all Philadelphia balloons go. In crossing the Delaware River, on this occasion, as well as others, when the surface of the water was unruffled, the bottom of

the river for half a mile up and down could be distinctly seen. The sand-bars and reefs of rocks under the water were nicely defined to the eye, and the *débris* of sunken matter was plainly visible.

After the river was crossed, at an altitude of 6000 feet, the air-ship received from a picnic party a grand salute of guns and pistols. A straggler of this party who had prowled beyond the limits of the pleasure-ground in search of game, finding nothing more inviting to his ammunition, took it into his head to make game of the balloon, and then and there projected a musket-ball at the unoffending air-ship. The smoke of the discharge curled up from below; and having gravitation on my side, the challenge was promptly accepted—not with cannon and villainous saltpetre, nor even gun or pistol. The answer was promptly given by the discharge of a six-pounder sand-bag in bulk, and right at the curl of smoke, as nothing but the hat-crown of the enemy could be seen, he having apparently planted himself in a hole five feet deep. Now, the ludicrous part of this memorable battle consisted of this—that the aërial warrior was about as ignorant of the law of momentum as was the sand-crab warrior of the common amenities of civilized life, as the sequel will show. With field-glass poised upon the descending sand-bolt, it was soon discovered that it would strike wider of the mark than did the antagonist's bullet. Gravitating matter dropped from a balloon loses not the momentum of the horizontal velocity it acquired in the balloon's motion. As the balloon was moving at the time about 4000 feet per minute, and the sand-bag having to travel downward about 6500 feet, which would require nearly a minute, allowing for atmospheric resistance, it will be evident that the aërial shot overran its mark by fully half a mile, striking an old shed-roof, as I learned afterward, and passing through it.

I was impressed from that time forth with the fact that air sailors should be careful how they fired at marks below. "Nobody hurt" was the best part of the whole affair. It may not be out of place here to say that the gyrating motion of bodies dropped from a balloon, and the very striking description given by the ancient poets of this peculiar motion in the descent of Jupiter's missiles, would seem to indicate that the ancients were well acquainted with and practiced in the art of aërostatics.

The unerring and impartial laws of nature, as I have said, made the destiny of our aërial vehicle to move eastward, and in that direction it was not desirable to sail any great length of time above a stratum of clouds that partitioned the earth from my view, inasmuch as the Atlantic Ocean, with its capricious wind, could not be far away in that direction—that is, when we count velocities of a mile a minute and territory not more than sixty miles to cross. Upon this reflection a gradual descent was determined on, and once more below the clouds, earth and its varied surface came to view. Calculating the angle of descent, with

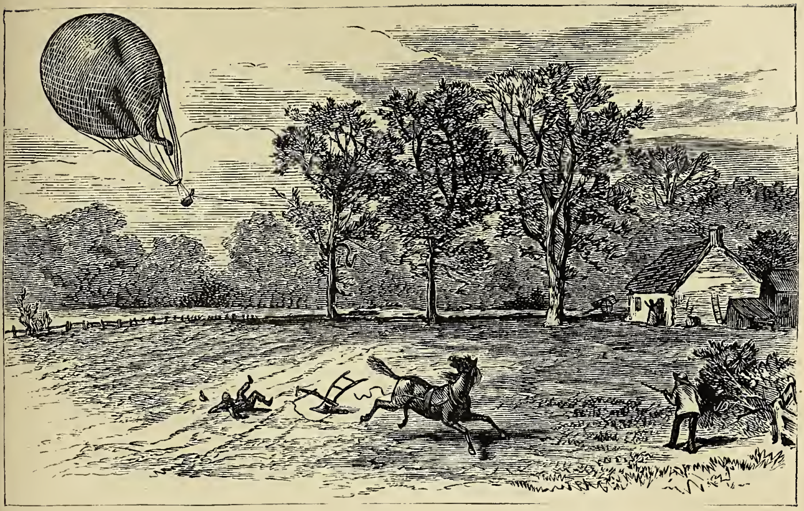
a view of locating the precise spot of coming to anchor, it indicated the landing-place upon a plantation large enough to ensure a pleasant port of debarkation; and upon nearing the earth, it was an agreeable emotion to find the air-ship darting into a Jersey peach orchard, in which a colored man was engaged in harrowing away the surface rubbish for the better lodgment of his luscious crop.

He and his team of horses were accompanied by two half-grown lads and two dogs. The anchor was thrown into a cluster of peach trees some distance in the rear of this field party; and as the wind was a brisk breeze, it dragged the anchor through the tender branches of the trees, and in a few moments the aërial paraphernalia was hovering over the agricultural party. The sudden apparition of the balloon, the anchor dragging in the harrow and over the horses, was not long in causing a stampede. The colored man was tripped up in the confusion; lying on his back, with the lines in his hand, he was dragged over the ground by the fleeing horses, the white of his eyes gleaming at the rustling body above him. The dogs were barking just as country dogs know how to bark when they are in doubt as to the identity of the thing that assails them; the two boys ran for the house with all their might, ever and anon falling over the retreating dogs, and the yelping of these canines, the wild screams of the boys, the snorting of the horses as they reared upon the gate leading to the barn-yard, the cackling of the poultry and the dismay in the pigeon-house, were enough to make one think he had landed in bedlam, instead of in an enlightened and civilized community.

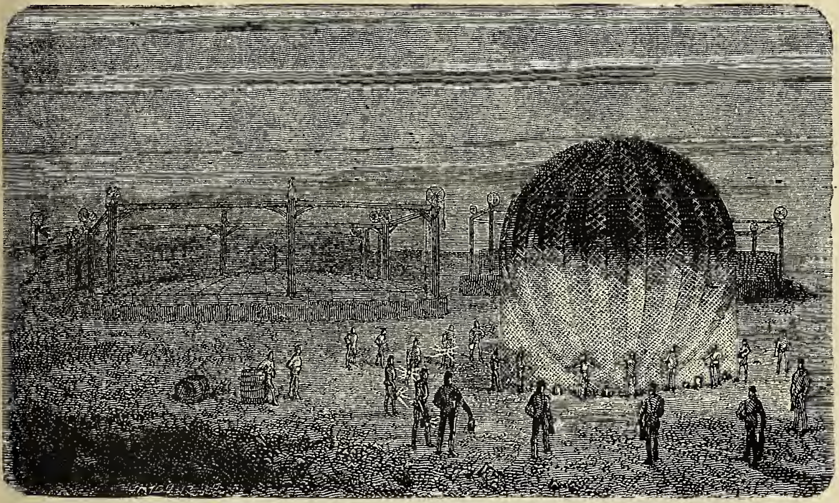
The frightened crowd lost nothing of its ardor as it neared the domicile of the farm. The balloon was there first, and was now fairly grappled by its anchor in an oak tree in front of the house. The matron of the household was standing in the doorway throwing up and down her hands, and in agonized wails straining her eyes in the direction of the coming boys and dogs; and no wonder, for the horses were kicking and snorting in their entanglement with the harrow and gate close by, and the noise of every animated thing around the premises was enough to alarm a woman of stronger nerves than belong to the most fearless of her sex.

The lord of the manor, Mr. Blank, of Middlesex county, N. J., was not slow in catching the infection; and while the silk of the flaccid part of the balloon was rustling above him in the tree-top, he cried out in a gruff voice, "Where is the thing? where is it? Bring out my gun, Martha—bring it out quick!"

While I had endeavored with all the force of my lungs and power of persuasion to calm the agitation below, it seemed only to serve to heighten the consternation. It prevented the terror-stricken boys and the negro man from coming to the house for refuge, and made them scream the louder; and while the father of the household was looking out



DESCENT IN A JERSEY PEACH ORCHARD.



INFLATION OF A BALLOON AT NIGHT.

a loophole through the outer limb of the tree for a shot at the balloon, it was deemed best and safest to cut the anchor-rope and depart. There was still a smaller grapple in reserve; and as this was being let out for the emergency, the balloon glided at an inconsiderable height over another habitation. In the garden attached to this dwelling was a woman, who was intently eyeing the approaching air-ship; and seeing the pending hook coming down, she quickly dodged under the currant bushes of the garden like a frightened rabbit. Another female present ran into the house, drew the door nearly shut, and then peeped through the slight opening after the balloon as it was passing. The remark from above of "Don't be alarmed, ladies," had no effect in calming their fears.

The wind being quite brisk, brought the air-ship over and along the line of a straight piece of road, and not far in advance of the balloon a horse and dearborn wagon were moving forward. The anchor was trailing barely on the ground when it reached the hinder part of the vehicle in question; and as bad luck would have it, it hooked under the rear of the carriage.

The balloon was now driven by the force of the wind in advance of the vehicle. This frightened the horse, and soon put him to a merry pace. The driver, apparently not less alarmed than the horse, was just as anxious to get from under, as every now and then the back of his wagon was lifted from the ground. To reason with him was to waste breath, and the only response he made was, "Oh, for gracious' sake don't take me up."

A short turn in the road brought the direction of the wind to an angle with the street, and the consequence of this was the lifting of the hind wheels of the wagon on the top of the fence, while the horse was struggling with all his might to get clear from the encumbrance. The driver had fled the scene, and was now out of sight. What was now to be done? If the anchor-rope should be cut, the balloon would dash into a rough piece of woodland—not a desirable place for a silken vehicle to land. If the anchorage should be persisted in, the horse would soon kick the wagon to pieces. Relief came at the critical moment. Two gentlemen seated in a barouche with a team of horses came galloping up, and by their aid horse, wagon and balloon were rescued from the dilemma in which the trio had fallen, as well as the air-ridden engineer who had caused so much consternation to the innocent people who chanced within his course. These gentlemen took me to a station on the Camden and Amboy Railroad, and in conversation on the way informed me that the man who owned the peach orchard was conscientiously opposed to education, and that the country people thereabouts knew nothing about balloons.

## CHAPTER XXVII.

Ballooning in England in 1850—Letter from Charles Henry Brown—The slow progress of aëronautic science.

MR. CHARLES HENRY BROWN, a young man of much intelligence and a great enthusiast in aëronautic matters, was a pupil of mine. He went to England with the expectation of being able there to gain more aëronautic experience and information than he could get in this country, and afterward located in Australia, where he made a number of fine experiments. While residing in England he corresponded with me, and furnished much interesting and valuable information. The following extract from a letter dated August 7, 1850, from Bradford, England, gives a review of the aëronautic situation which is worthy of the reader's attention:

"BRADFORD, England, Aug. 7, 1850.

"SIR: Aërostation is yet destined to produce great changes in the condition of mankind; and though many persons, and indeed nearly every one, think that a balloon cannot be guided in a direction from that of wind, this can be done. By means of a sail a balloon can be directed either over water or land when a drag is employed; the drag retarding the balloon, the sail will fill. Certainly we cannot force a balloon against the wind, but we can deviate from the line of a current. The possibility of directing balloons should be boldly proclaimed in every quarter. The public are under the impression that aërial navigation is an impossibility, and, therefore, take little interest in it, and most of the professional aëronauts of the present day are doing great injury to the infant science. On the 7th and 14th of last month, M. Poitevin, the French aëronaut, made two ascents on horseback with a balloon, which ridiculous feat was copied by our own veteran aëronaut Charles Green. At Lyons, in France, some years ago, Margat ascended seated on a stag, and only last year Lieut. Gale took a lion up with him. The London papers, in speaking of Green's ascent, say that 'aërostation, abandoned by science as a hopeless speculation, has become the legitimate property of the caterers for the amusement of the public.' A little noise has lately been made here about a new aërial machine which

was patented in 1848, by a Mr. Hugh Bell, of London, a medical gentleman. Many things claimed by him as his invention were proposed by other parties many years before. Mr. Bell has made two ascents with his machine; the first trial was private and was most successful, the papers stating that Mr. Bell could give any direction to his machine. In the descent on this occasion a man was killed by the grapnel. Mr. Bell's next trial was a public one, made at Vauxhall, but failed, owing, Mr. Bell states, to a supply of gas of bad quality. The balloon is nearly in the form of an egg, being 50 feet long and 22 in diameter, and will hold 15,000 cubic feet. Bell was announced to be accompanied by Captain Dryden; but the balloon not having sufficient power to carry both, Mr. Bell ascended alone, and he states that the machinery, which had been arranged for two persons and could not be managed by one, was on that account totally useless. The machine went in the direction of the wind. Bell is, however, confident of success, and speaks of making another trial. If he does not succeed, he deserves credit for what he has already done, by showing a good example to our professional aëronauts. He will make them ashamed of their usual "up and down" system. They have had fine opportunities for improving aërostation, and they missed them. Green has many rich friends who would have assisted him. Mr. Holland, member of Parliament for Hastings, projected the Nassau trip, and paid all expenses attending it. Green might have done something on that occasion; he did not even give the guide-rope a fair trial. In my log-book I have the particulars of 700 aërial voyages, most of them remarkable ones, together with other memoranda relating to the science, and I have also about a dozen works on the subject.

"The two ascents made by you from Easton and Carlisle were noticed at the time in our newspapers, and you will perhaps not be surprised when I tell you that those accounts were disbelieved, and by aëronauts too. Mr. Hampton and Mr. Russum, both aëronauts, the former having made 50 or 60 ascents and the latter 9 ascents, will not believe that you intentionally exploded your balloon at Easton. They both say the performance is a highly dangerous one, and such an experiment as no man would attempt to make. Although Hampton has made three parachute descents, he has told me that he will not attempt another unless tempted by an offer of a large sum of money. In my opinion, he is a very unfit man for his profession; he has not the confidence in a balloon that you appear to have, and he says that the conduct of Mr. Graham and Lieut. Gale, two of our professional aëronauts, is shameful in allowing their wives to go up with balloons. Mrs. Gale has made many ascents. Mrs. Graham last week made her 54th ascent, with her son and three daughters. This lady is rather a heavy person, weighing about 220 pounds. Graham himself has made 50 or 60 ascents, and Lieut. Gale about 100. Graham has had

many accidents; Gale has not had one. Last month Gale was carried over to the coast of France with his balloon, crossing over 100 miles of water in 5 hours. On his descent, not having a passport, he was seized and taken before the mayor of Dieppe, where he was examined, but was finally set at liberty by our consul. The people would not believe his story of having crossed the Channel with a balloon. When Gale first appeared in public here, he brought out a very clever contrivance for preserving the gas which escapes from expansion from the neck of a balloon. For this purpose he had several small balloons which could be raised to the equator of the large machine, and the gas as it escaped from the neck was to be conveyed by means of long tubes into the small balloons, so that a great height could be attained without losing any gas. In descending the balloon would collapse; the gas could then be passed from the small balloon into the large one, so that it would reach the earth in the form in which it ascended. Besides this contrivance, Gale employs two cars so arranged that one can be lowered 20 or 30 feet below the other. A rope ladder connects the two cars, so that the aëronaut can easily pass from one car to the other. From the lower car Gale discharges fire-works in his night ascents. He has made many ascents at ten or eleven o'clock at night. The balloon which Gale uses now belongs to James Goulston, of London, who has made many ascents with Gale and takes great interest in the science. Chas. Green, the veteran, is noted for the great number of ascents which he has made, for having first employed coal gas in his ascents, and for bringing into use the guide-rope. In 1784, at Louvain, a small balloon was filled with coal gas by M. Thysbaert; the ascent of it was quite successful. In 1816 a Mr. Bland proposed the use of coal gas for balloons. Mr. Green was the first to make an ascent with it.

"In 1836, when Green was in Paris, the Société de l'Industrie Français bestowed on him a medal for *his invention* of the guide-rope. It does not appear to be generally known that the guide-rope was the invention of Thomas Baldwin, of Chester, being described in a work entitled Airopaidia, and published by that gentleman in 1786.

"Baldwin calls it the balance-rope, and says that by means of it a balloon can be kept at a certain level. The guide-rope is very valuable for pointing out the course of the balloon when the earth is hid from the view of the aëronaut. Green says he can distinguish what kind of ground he is passing over at night by the noise made by the rope in trailing along the ground. Many scientific men raise objections to the use of the guide-rope on account of the damage likely to be done by it to houses, etc., which lay in its course; but these can be avoided. The guide-rope will act as a drag; and as I have said before, a sail will fill and the rope be made to avoid the houses by working the sail. Green's first balloon was thirty-one feet in diameter, and was destroyed in the sea off Beachy Head, where he descended on his fifth voyage. In 1822

he made another balloon one hundred and seven feet in circumference, and in an ascent with this balloon from Leeds, in 1823, he went forty-three miles in eighteen minutes, was thrown from his car, and the balloon went over to Holland. In 1826 he made another one hundred and twelve feet in circumference, and this balloon he has yet. He lately made a night ascent with it at Vauxhall. This balloon has ascended about three hundred times. Green has four balloons, the Nassau, the Albion, the Coronation and the Victoria. The latter two are each one hundred and twelve feet in circumference, and the Victoria is the last he made. The Albion formerly belonged to Hampton, Green having bought it of a person to whom Hampton owed some money, and who held the balloon as security for payment of the money. The Nassau balloon was made for the proprietors of Vauxhall gardens; but they becoming bankrupt, the balloon was sold by auction to Mr. Green for £500. Several remarkable ascents, in addition to the trip to Nassau, have been made with this machine. Cocking's parachute was carried up with it. In 1838, Green, Rush (an American gentleman who has ascended with Green sixteen times) and Spencer made a remarkably fine ascension, attained a height of near four miles, and four days afterward Green and Rush attained a height of 27,146 feet. In May last Green and Rush attained a height of more than four miles, and on the 30th June they rose to a height of 19,440 feet, and in descending were nearly drowned in the river Thames. Thirteen persons have been taken up with the Nassau balloon, and on many occasions twelve persons have ascended with it. In 1784 an enormous balloon ascended from Naples with eighteen persons, and in 1794 Blanchard and fifteen others ascended from Rouen. Spencer, who was with Green when Cocking was killed, was Green's solicitor, and it is said that Green, being afraid of the experiment terminating fatally, took Spencer with him to see all done right. Green, Spencer and seven others, in an ascent from London in 1838, remained over the city more than three hours. They were over a lime-kiln half an hour. Spencer made forty-three ascents. Captain Currie made about fifty ascents with Green and Mr. and Mrs. Graham. Green has several brothers who have made many ascents. George made about one hundred, then gave up. William has made a great number. Henry has made about one hundred. Charles Green has a son named George, who has made more than two hundred ascents. Females of that family have made great numbers of ascents. Green's son has been ballooning in Germany, France, Belgium and Prussia the last three years. Hampton is noted for his parachute descents, and for the many accidents he has had. In his first ascent he broke his arm, in the second he fell in the sea, and in the fourth he also fell in the sea; four days after, he ascended with his arm in a sling. On his first parachute descent he was insensible for some time—this he told me himself—and he received a cut over his eye. The

second descent he was dashed violently against the side of a house; the third descent he fell among trees, and was nearly killed. In an ascent from Dublin his balloon came in contact with a chimney on fire; the balloon exploded; he leaped from the car, rolled off the roof of the house, and would have been spiked through by some iron palings, had he not been pushed off in his descent by a man who was standing by. Since that time he has twice fallen in the Irish Channel. He is now experimenting with a large fire balloon forty-five feet in diameter, but he does not appear to succeed with it.

"Henry Coxwell, another of our professional aëronauts, has gone on very successfully, so far; he has made many ascents. Like young Green, he is making ascents on the Continent. He lately ascended from Hamburg, in Germany, with Prince Paul Esterhazy. In 1848 he ascended from Brussels, and went a distance of fifty-five miles in twenty minutes. He invented a water-car for sea-voyages. He was a short time editor of the 'Balloon, or Aërostatic Magazine.'

"In 1847, Coxwell, then an amateur, made an ascent from London with Richard Gypson (another professional aëronaut) and two other persons, about ten or eleven o'clock at night, with a discharge of fireworks from below the car. When six thousand feet high, the balloon burst. The neck of the balloon was tied to the hoop above the car. Coxwell was standing on the hoop. He cut the string which held down the neck; the latter was jerked violently up to the crown of the balloon, a parachute was formed, and they descended safely in London. In the descent the balloon and netting were covered with sparks from the fireworks, threatening every moment to blow up.

"Richard Gypson, above mentioned, has made one hundred ascents. In 1839 he brought out a new valve by which he could exhaust his balloon in forty seconds. He did not adhere to this plan long, I think, for in 1843, in a descent near Dublin, some scoundrels cut the ropes which secured the car to the balloon; the latter instantly disappeared in the clouds, and has not been heard of since. It is said that this balloon cost between five and six hundred pounds.

"Mr. William Wadman, gas-fitter, of Bristol, commenced ballooning in 1847, and made seventy-two ascents with a balloon called the Rainbow, thirty-four feet in diameter. He died in August, 1849. It is said that his balloon caused his death. It appears to have been very porous, scarcely ever remaining aloft more than ten or fifteen minutes.

"A young man named Richard Green frequently ascended with Wadman, but the latter, having received some injury, was not able to manage the balloon; therefore young Green took the management. In an ascent from Cardiff he was drowned in the Bristol Channel; how, is not known. The balloon was found twenty miles inland, next morning; the things in the car were wet. There was (Wadman states) about one hundred and fifty pounds' weight of disposable articles in the car

that young Green might have parted with. His body was washed ashore a week after.

"Arban, the French aëronaut who crossed the Alps in a balloon, was drowned on the 2d of October in an ascent from Barcelona, in Spain. Another mystery. His body was washed ashore a week afterward. He had made many ascents in France and Italy. In June, 1849, he made his thirty-eighth ascent from Nîsmes.

"Fifteen persons have lost their lives with balloons—some through inexperience, some through carelessness and want of presence of mind. In Spain a French rope-dancer, named Grellon, ascends with a fire balloon on Vardalle's plan, but Grellon has no car. He performs gymnastic feats during his ascent. He takes no fire with him, nor anything except a small grappling-iron. Vardalle has had two or three narrow escapes; at New York he fell in the river.

"Ballooning has come to something, at last, what with the exploits of a rope-dancer and of equestrian aëronauts. A successful parachute descent was made in Paris last month by Margat. They are at present balloon-mad in that city. Two or three balloons ascend every Sunday. There has been a great deal said there lately about a new flying-machine which is being constructed. We shall most likely hear more of it by and by. A Senor Montemayor said he would come from Madrid, in Spain, to London, in a day. This is about three months since; he has not come yet. I do not like to hear people promise things and not attempt their performance."

# CHAPTER XXVIII.

Geology of the atmosphere—Cloud strata—The original "Old Probabilities," Professor Henry's, weather predictions—The practical advantages of scientific knowledge.

IT would seem at first thought that the term "geology of the atmosphere" was a mere fancy misnomer, but it is as much a matter of scientific fact as is the geology of our planet's crust. Indeed, while the geology of the earth's crust confines our positive observation within the limits of one or two thousand feet beneath its surface, that of the atmosphere allows us a practical scope of examination of 30,000 feet above its surface, and of that portion of it most interesting to our welfare and study. Now, whatever the condition of terra firma may be beyond the point of certain examination in regard to its crust and internal structure—whether solid to its centre or hollow like a geode, or whether filled with plutonic lava, as some physicists maintain—we do know that the geology of the atmósphere proves it to be a stratified elastic substantive shell to the distance of as many miles outward as you choose to count it, under the law of geometrical diminution of density, which brings it so near to a nonenity at forty or fifty miles above the earth's surface that the atmospheric philosophers have placed its ultimatum at that limit, but they forget to tell us what begins where the atmosphere ends, leaving us in a sort of philosophical quandary, and so we may as well come down into the shell of our subject, for shell it is as certainly as a shell encloses the embryotic egg of the animal.

True it is that we shall not find it near so difficult of penetration through its strata as the granitic layers of its correlative basement, or even the liquid shelves of hot and cold brine on which it mainly rests, but we shall nevertheless find it possessed with counterparts as interesting to contemplate as are the old red sandstones and primitive serpentines of the nether geology.

Viewed from afar off, as we might see it from a standpoint on Mars or Venus, we should in all reasonable probability find the semi-transparent geology of our atmosphere to present us with a field of view similar to the belted Jupiter or striated Mars, since we have such well-defined bands in the torrid, the temperate and the frigid zones that must

of necessity give aspects in accordance with their temperatures, their reflections, their underlaid water bases, liquid and frozen, and one persistent equatorial cloud-belt that shifts itself in accordance with the earth's declination to the plane of its orbit.

But this is discussing our subject from too speculative a position; and while it might serve us as well as the astronomy that teaches us as to the outlines of land and water on our neighbor Mars, and that Saturn's rings are not yet broken into flinders by centrifugal force, to be aggregated into moons, and that our little daughter Silvia has become a sapless old maid, wellnigh played out and going the way of all things changeable, and that the sun is a huge caldron of molten metal, with a red-hot blazing photosphere around it, that sometimes, in some parts of it, bubbles up like a pot of melted saltpetre, occasionally bursting a bubble, as witnessed by Professor Young, heaving up its liberated phlogiston to the height of 50,000 miles or more in less time than it takes to tell it,—we feel constrained to come back and examine the positive geology of our own atmosphere as we find it hugging the solid earth.

While the gravity of our earth, by which all the other planets are weighed, at best is purely hypothetical, the weight of its atmosphere can hardly be questioned, as demonstrated by the Torricellian balance. That instrument tells us that our atmosphere is equal in weight to a shell of water thirty-four feet thick encompassing the whole world; so we have a positive data of its weight, and have a good foundation to start on in the investigation of its geology. Now, as it may safely be alleged that the general stratification of the atmosphere is constantly liable to slides, and heaves, and avalanches, and shiftings, as compared to the geology of the more solid crust of the earth, the difference is only as to time. While the one is liable to changes in short periods of time, the other is just as liable to changes in long periods of time; and in the one case, as in the other, the relation they bear to that infinite eternity is all the same as regards the computation of time and change.

That the atmosphere has its fixed geological strata is manifest in various indisputable conditions of constant recurrence, well known to the seafaring and airfaring man, and he knows them as well in their courses as does the engineering landsman know the courses of the Rocky Mountains, the valleys of the Mississippi and the Amazon, or the ranges of the Cordilleras.

The trade-winds were for a long time only studied and understood as related to ship-sailing voyages, as the squirrel understands and practices the art of crossing rivers, as a failure of the nut-crop makes it a necessity to migrate from one side to the other. Now, since we are a little more advanced from the ancestry which Darwin gives us, we are prone to look a little higher, and that, in accordance with the law of progress, leads us to study the higher strata of the atmosphere, with a view, if

not to make ourselves wings to fly with, at all events floats to sail with that bring us face to face with aërial highways, mountains and valleys, streams and counter streams, tides and storms, layers of clouds, warm and cold, just as we find stratifications, tides and gulf-streams in the more crude form here below; and thus we behold that unity of force and law in Nature that moves and vitalizes all things with its providential life and motion recognizable in the multifarious forms of matter springing out of it.

While it belongs to the study of geology in the denser crust of the earth to investigate the phenomena of earthquakes and volcanoes and geysers, it belongs to that of the atmosphere to investigate the phenomena of the cyclones, the tornadoes, the cloud-bursts and the fiery explosions of electricity, as they occur in the more attenuated crust round about us; and this, if not a more sublime study for our material nature than the other, does at all events lift us up a degree in the scale toward a more spiritual life.

That great centrifugal furnace of our equator, with its seething band of heated and volatilized vapor, that is pumped up as it were by a tremendous irrigating engine, as if made expressly to send heat and moisture to the uttermost parts of the earth, is of itself a grand and interesting study before which the heaving fires of Vesuvius are comparatively tame. That is the stratum which has not yet received its full share of consideration in the cosmogony of our planet, but rather neglected and left to the unimaginative sailor, who conjures it up into "calm belts" and "horse latitudes," and into "doldrums" and "crossings of the line," etc.

Owing to the configuration of the globe in its continents in connection with the motion of the earth and the gulf-streams that are projected from this huge steam-generator, the mariner tracks out his roads and byways as definitely as does the civil engineer his glades and valleys in his surveys. And while this great engine is moving the waters of the sea, it is just as diligently at work in moving the great ocean of vapor over our heads above, presenting the grand conjunction of the trade-winds rushing into this equatorial vortex from the northward and the southward, only to be raised and convected outward, freighted with its life-giving materials, to be distributed over the land in the mechanism of its ways, as constantly as is the blood of an animal in its peculiar economy.

The ways of Providence are wondrous wise; and when we pray for rain when it is dry, and for dry weather when it is rainy, we only succeed in betraying our mean little selfishness and expose our ignorance of the immutable laws of nature that can neither be cajoled nor coaxed by human supplication, and thus we stultify our ignorance of the wisdom that governs the universal cosmos for the general good.

"Old Probabilities"—I mean the original one, Joseph Henry—gave

me a lesson in this weather prediction sixteen years ago. With his weather map before him and a telegram from St. Louis describing a storm then and there in action, he began to trace it by sticking pins into the map. As we had been discussing the nature of the storms and the upper trade-winds the evening before, I remarked, "You ought to be able to tell when that storm will reach the meridian of Washington," and he did predict it truthfully. He further remarked, "You know the snow-storms always commence in the West; and whenever I get a telegram from St. Louis of a snow-storm raging there, I can tell about what time it will reach the Atlantic sea-board." It is only when the east wind of winter forms a conjunction and an atmospheric node with the west wind that a deposition of snow takes place, and this winter node of snow, rain or sleet always travels eastward. Our weather signal service is mainly indebted to the early experiments of Henry; for as soon as a general system of telegraphy was established, weather predictions was an accomplished science, and he pressed the matter as a necessary and economical action of the government for the benefit of seamen and agriculturists.

Such is the use of the study of the geology of the atmosphere; and while it would be too prolix to attempt the details of areas of high and low barometer, and the exact tracing of isobarometric lines indicative of the course of the storm, it is safe to conclude that high and low barometer is only an effect of the storm motion—that is to say, the condensation of the atmosphere, caused by its pushing forward, makes the mercury rise, while its dilation, following in the wake, causes the mercury to fall.

The heat and force that actuates all our storms comes from the intertropical belt of our planet, and they ever take their rise from the vapor that is pumped up by the great centrifugal engine of the equator, and from thence sent north and south in the form of cyclones, and from the offshoots of these come our more northern gusts and storms, never so great and grand in the temperate zone as in the tropical.

It does not belong to the solid earth alone to develop the stratification of horizontal and inclined layers, since we find the atmosphere presenting a similar condition. We frequently see the stratum of clouds with their feather-edged outlines as clearly defined as any stratification in the solid crust of the earth; and when the setting sun throws her golden sheen over them, their form and figures require no vivid imagination to trace the geology of the atmosphere. We also find an expressive counterpart of the upheaving earthquake and lava-projecting volcano in the down-heaving waterspout and fire-projecting thunderbolt.

The great balance of nature is vibrating all the time with exact rhythmical motion; the earthquakes, cyclones and volcanoes are but bars and semiquavers in the harmony of the universe, and we, short-sighted

creatures, often look upon them as catastrophes, and, with the uneducated, as the visitations of an offended Deity.

Popular science will lift us above the superstition that whistles up the wind for the ship, and that invokes the Deity to alter his decrees of natural laws, because it teaches us that what takes place in the heavens above and in the earth beneath are purely necessary results in the workings of the universal cosmogony. Science lifts us up above the musty proverb "that wastes its breath upon the desert air," and that nature has a vacuum. Under the knowledge of the day, it would be as difficult to conceive a vacuum as it would be to conceive the limits of space or the end of time.

The shell of atmosphere that enfolds the solid earth is full of life and full of uses. One of its uses is yet to come. When man shall have studied more fully its matter and its conditions, its highways and its byways, its mountains and its valleys, its tide of flux and reflux, its capacity to float ships of copper or iron (a balloon made of copper plate, weighing a pound per square foot, and of one hundred feet diameter, will float in the air), then shall we also appropriate the knowledge of the atmosphere's geology to our use as a means of devising fleet and pleasant travel.

The individual who nowadays neglects to look at "Probabilities'" enunciation in the morning papers, especially when he says an area of low barometer will pass over you to-day, and determines to leave out his hay for the morrow or goes out on the day's excursion without his umbrella, deserves to have his hay sopped with rain and his garments soaked with an admonitory moisture.

A more advanced theory of the geology of the atmosphere will teach us to predict earthquakes, as it is already more than surmised that the elastic shell of the atmosphere pumps up a bubble in the shell of the earth, and then lets it sink again, as does the india-rubber ball the water when we press the ball and then suffer it suddenly to expand.

## CHAPTER XXIX.

Ascent from Zanesville, Ohio—Thistle seeds in the higher atmosphere—A magnificent panorama—Ascent from Columbus, Ohio—Grand sunset scene—Relief from sickness—Ascent from Springfield, Ohio—Cold at an altitude of fifteen thousand feet—Ascent from Cincinnati—Curious noises arising from the earth.

ON the 15th of August, 1851, I made an ascension from Zanesville, Ohio, leaving the earth at ten minutes past three o'clock with the air-ship "Ulysses." The atmosphere was calm, with a light breeze from the north near the surface of the earth. The balloon was full when I started, making my ascent slow and graceful. By an alternate discharge of gas and ballast the vessel mounted to an altitude of a mile and a quarter in an hour after I had started. While over the city of Zanesville it was at no time over three-fourths of a mile high, and the highest point was not attained before I got five miles south of the town.

The atmosphere was somewhat filled with the pollen of thistles, as high as I went, and many could be seen far above me when at the highest point. These vegetable parachutes sailing through the air with their seed-bearing cargoes were, no doubt, fulfilling a destiny in the vegetable kingdom, through a faculty possessed by all kinds of pollen that we are little acquainted with.

At my greatest altitude I made a general observation of the country around. It was a most magnificent sight. Plantations innumerable were spread out below, village upon village crowded the scene, roads threading the vast plain in every direction; it looked like a panorama painted by the pencil of God. This latter thought always occurs to me when viewing a beautiful country from a great height through an atmosphere perfectly still and serene. The very stillness that surrounds you is sublime, and is calculated to enhance the beauty of the scene below; and giving rise to emotions that can only be appreciated by being experienced, it makes the soul leap with joy.

The territory north-east of the town has the most clear land, although it is as numerously interspersed with patches of wood as the rest, but the patches are smaller. The city of Zanesville had a most beautiful appearance, from its being so generally embellished with flower-gar-

dens; these relieved it from its dingy cast caused by the use of bituminous coal. The shape of the city is like the lower part of a balloon, the neck terminating at the bridge of the National Pike, crossing the Muskingum at its western extremity, and curving into an enlargement toward the east. I mention these things because they were so beautifully and distinctly portrayed.

About fifteen miles to the north-west a wide, meandering stream of water could be seen bulged up, as it were, above the level of the earth; it was apparently much broader than the Muskingum. The water of the Muskingum presented a translucent appearance; and although very muddy, the bottom of the river was distinctly to be seen for several miles each way.

While at the highest point, I heard for a moment very distinctly the noise of the dam of the river, and at the same time the clattering of horses' hoofs galloping down the road, which died away after three or four undulatory echoes, or, perhaps more properly expressed, vibrations.

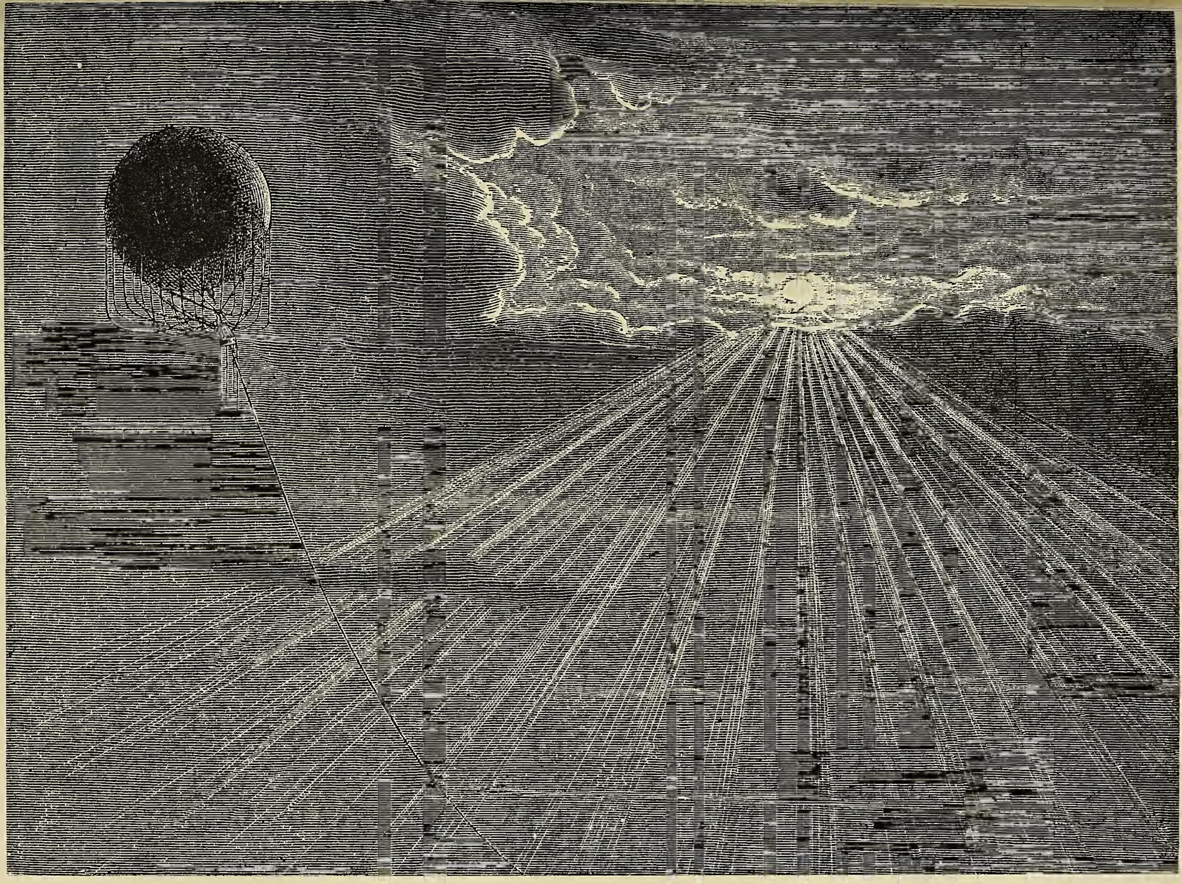
There is something peculiar in the hearing of sounds proceeding from the earth upward, and the subject is one which may be worth particular investigation.

My attention was more particularly given to the motion of substances thrown from my car. They all spun on their axes. Light oblong pieces of paper, when thrown out while the balloon was sailing in equilibrio, invariably followed the vessel for some minutes a little below the level of the car and forty or fifty feet off horizontally, presenting an angle of about forty-five degrees, their upper points toward the balloon, and spinning upon their longer axes as rapidly as spindles in a cotton factory.

I threw overboard a light empty pint bottle, which fell in large spiral circles, giving out a very musical sound in its descent. This did not spin on its axis, but turned slowly on it as it descended.

Having now been up an hour and a quarter, and seeing the road on both sides of the Muskingum filled with horses and vehicles, many of them evidently pursuing the balloon, I made preparations for a descent, which was handsomely made about six miles south of the city.

On September 5, 1851, I ascended from Columbus, Ohio, at five minutes before five P. M., with the balloon "Ulysses," the car containing Mrs. Wise, Master Charles Wise and myself. The atmosphere was calm and clear, with a gentle breeze from the south-west; velocity of breeze about ten miles per hour. At twenty minutes past five we were 2500 feet high. The prospect was grand and clear for thirty miles each way. Mrs. Wise and Charles were in a state of excitement not far short of that produced by inhaling nitrous oxide gas. The various public buildings, the State Fair ground disgorging its immense mass of animated nature, the crowded city, the great museum pavilion, teeming like a bee-hive, with the magnificent scenery all around, were indeed



"THE SCENE AT THIS TIME WAS A GRAND ONE."

enough to exhilarate less excitable minds than my own. It was with difficulty that I could restrain my companions from jostling the car to and fro in their nervous enjoyment. I requested them to make notes with pencil and paper, but I found this too insipid an employment for their state of mind, so I had to attend to it myself.

At twenty-five minutes past five I notified my companions of my intention of landing them and resuming the voyage alone for the purpose of making experiments. At thirty-five minutes past five we landed on Mr. Noble's farm, four miles from Columbus. Charles alighted, but Mrs. Wise insisted on reascending with me, but after getting up 300 or 400 feet I found out I could not attain a height desirable with the weights in charge, so we landed again; and after leaving out Mrs. Wise, I reascended alone and attained an altitude of 10,000 feet, when I entered a stratum of mist—it was highly electrical—agitated by convulsionary air wheels. In this mist and above it, everything in and about the balloon became intensely elastic—a spruceness, if I am allowed the term, pervaded the whole mass that rendered it quickening and musical. The touching of the valve-cord produced sounds from the valve-spring like a guitar; the cords by which the car was suspended gave out sounds like a stringed instrument at every whirl of the electric medium.

When in the mist it had the appearance of dust, but viewed from above it had a dingy and gloomy appearance. It was a distinct stratum several hundred feet thick. When above it, I could see the country elevated above a tier of clouds to the south-east, fifty or sixty miles distant. The condition of the atmosphere above was truly singular, a condition no doubt in some way connected with the long-prevailing drought from which the country had been suffering.

I was aloft until sunset. The scene at this time was a grand one. The tops of the clouds in the distance were magnificently illuminated and variegated with the colors of the rainbow. While viewing this scene from over a mile high, my attention was suddenly drawn to a conversation passing between two individuals. At first I thought it was a delusion, but upon close observation it proved to be a fact, for I could distinctly hear words, such as "I don't know," "Did you see him?" I tried the experiment upon my own voice, and found it to echo distinctly, which also brought shouts, probably from those whose conversation I heard. This happened over a little stream, at a clear point entirely surrounded by woods, and just at sunset.

Although the air at this point was only forty degrees, my pulse was quickened to no less, I judge, than ninety a minute, and my veins were considerably distended. I felt that I was getting much relief from sickness I had labored under for several weeks, and I can candidly say that I felt a permanent improvement of health really astonishing to myself, and altogether ascribed to the electrical invigoration received

in a highly-charged atmosphere. This was one object in resuming my voyage after Mrs. Wise and Charles were landed.

While passing through the cold electrical stratum, theory would assign to the gas a loss of buoyancy from condensation, but in this case its buoyancy was increased, as I am certain the ascent of the balloon became accelerated from the time it entered it, without discharging any ballast. At fifteen minutes past six o'clock I neared Blendon Corner, about ten miles from Columbus.

On October 1, 1851, I made an ascension from Springfield, Ohio, leaving the ground at thirty-five minutes past five, with a breeze from the south. Fifteen minutes after I started, the balloon penetrated the lower layer of clouds immediately over the village of Mechanicsburg. At this point it made a complete circle in towering up through the upper layer, and made a tack directly eastward. Upon examining my State map, I learned that I should strike a point over the city of Columbus in about thirty or thirty-five minutes, from the speed at which I was going, being over a mile a minute.

After having traversed the cloud region for thirty minutes at an altitude of 15,000 feet, with the thermometer down to 16°, I found myself compelled to descend into a more congenial region, being much benumbed from cold, and desirous of learning my whereabouts.

When I got down within about 10,000 feet of the earth, I discovered Columbus a little eastward, and at once commenced a rapid descent, calculating to land three miles north of Columbus, but such was the velocity of the wind that in five minutes more I was carried six miles beyond the point I had chosen for a landing, and was brought to anchor on the top of a dense forest eight miles north-east of Columbus, from whence I was finally brought to the earth by the timely aid of a wood-chopper who came to my assistance.

The distance travelled was not less than sixty-five miles, and the whole time occupied was fifty-eight minutes.

The cloud scenery was truly grand, like a vast ocean of down, with here and there beautiful defiles and splendid conic sections. I could not resist the idea of an inclination to plunge into the vast downy ocean and take a bath in its alluring mists.

In looking through the defiles of the vast pile of clouds, the earth presented an enchanted appearance.

On the 9th of the same month I made my 127th aërial voyage, leaving Cincinnati at ten minutes before five o'clock P. M., in the air-ship "Ulysses," with a breeze from the south-east. In twenty-two minutes after, I reached the current always blowing toward the east. This caused the balloon to describe a semi-circle around the town, as it towered up through the eddy. While scanning the city from this point, it presented in shape the appearance of a huge frog with its hind legs distended.

As I rose higher, the city merged into a compact mass, showing very

faint lines, but the Ohio glittered like a silver band around its south-eastern border. A murmuring noise arose from the city like the sound of a bee-hive, but in the midst of the hum the enchanting strains of a band of music fell distinctly on my ears.

This strange incongruity of sounds made me feel somewhat poetical, and I could not help exclaiming, "O Queen City! shake yourself in all the spirit of your enterprise; you have all the quickening elements of unbounded moral prosperity."

Just as I got over Cumminsville the breeze tacked to the east, taking me directly over the Spring Grove Cemetery. The cemetery grounds had the appearance of a ribbon, shaped something like the "true lover's knot," and the country round teemed with villages and avenues as adjuncts to the great Queen City. I never hovered over a space that seemed to teem with quite so much life and vigor. Although out of the reach of sound from common operations, animated nature developed itself intensely strcng in everything that reached the eye. If it were possible to daguerreotype such a picture, it would make one of the most beautiful panoramas that human eye ever saw. While I was thus revelling upon the moral grandeur of Cincinnati and its environs, my elated ardor was suddenly cooled by the trespass of a dense layer of clouds, which suddenly curtained the day-god. This almost as suddenly changed my poetical musings into shaking chills that caused my very teeth to chatter.

Now the earth looked sombre, almost swallowed up in darkness; the air-ship "Ulysses" began also to partake of a drooping spirit; the sudden cold condensed the gas, and gravity became the ruling principle all round, and I followed it down to mother Earth, which I reached ten minutes after six o'clock, eight miles from the city, in Springfield township, on the farm of Mr. Cummins.

## CHAPTER XXX.

Trans-Atlantic project—Memorial to Congress—Advocacy of Senator Stephen A. Douglas—Debate in the United States Senate.

A TRANS-ATLANTIC balloon voyage having been the dream of my lifetime, I determined, in 1851, to appeal to Congress for aid, being convinced that the experiment, if conducted under proper auspices, must be successful, and lead to results of the greatest benefit to society. My appeal was warmly seconded by my friend Surgeon Foltz, of the United States Navy, who personally represented my case to Senator Douglas and several other members of Congress, and succeeded in interesting them in the project. The following petition was, therefore, presented in the Senate by Mr. Douglas, and in the House by Mr. Maclean, of Maryland:

"*To the Honorable the Senate and House of Representatives of the United States, in Congress assembled:*

"The petition of the undersigned respectfully showeth that he is a native and citizen of the city of Lancaster, Pennsylvania, and that for a period of sixteen years he has devoted all his time, study and labor to the art and science of aëronautics; that during that time he has made some hundred successful aërial voyages in different parts of the United States; that he has repeatedly completely exploded his balloon two miles in the air and has descended uninjured, protected by the atmosphere alone.

"That he is the author of a work on the history and practice of aëronautics, the only complete work on the subject extant, and of which another edition is about to be published in this country and in England, and that the work has met with the most flattering notices in the 'London Despatch,' 'London Athenæum,' 'London Literary Journal,' 'London Historic Record,' and other established European journals, as well as those of our own country.

"That the result of these aërial voyages of the undersigned, as well as from a most diligent search into the facts elicited from the experience of others, has clearly demonstrated that in our latitudes there is,

in the elevated regions of the air, a perpetual current of the atmosphere from the west toward the east, and that by means of it an aërial voyage round the globe may be made in a comparatively short period of time.

"That your petitioner would most respectfully remind your honorable bodies that all aërial voyages heretofore have been the result of private enterprise, and at an outlay of a very small amount of money, and that he is well convinced that long before the same amount of money, of labor and of talent which has been devoted to the art of navigating the seas shall have been bestowed upon its sister art of navigating the air, it will be brought to an inconceivable degree of greater perfection and usefulness, both in peace and in war.

"He would further respectfully remind Congress of the puny vessels of eighty and one hundred tons burden with which Columbus discovered the New World, as compared to the monster leviathan three-deckers of three thousand and four thousand tons which now move with such speed and safety upon the mighty deep.

"Greater improvements and discoveries might still be made at a comparatively trifling expense, but they are beyond your petitioner's means, and he respectfully but earnestly calls for a consideration and aid to his projects, which he will so speedily demonstrate to the people of this country and to the world to be practicable.

"He respectfully asks that Congress may be pleased to make an appropriation of $20,000, to be expended in the city of Washington, under the direction of the Secretary of the Navy, the Secretary of War or the President of the Smithsonian Institute, or the Superintendent of the Astronomical Observatory.

"With this sum he will construct a balloon of such material as will retain hydrogen gas for weeks and months, of a diameter of one hundred feet, which will give it an elevatory power of sixteen tons. With this balloon he will make numerous and repeated topical ascensions from the city of Washington, and being properly secured to the earth, will hover over the Navy Yard, Arsenal, Capitol or President's house, or any other point, out of reach of shot or shell, and from thence discharge imitation destructive missiles, showing his ability thus to destroy any fleet, fort or army which may be beneath him; he will demonstrate that any hostile fleet which may anchor in the waters of the United States can thus be destroyed.

"He purposes, further, to make numerous topical ascensions to verify his previous observations as to the existence of the aërial current at all times blowing from west to east. After having satisfied the community upon these points, of which he is already convinced, he will convey the balloon to St. Louis, Mo., then ascend and cross the Alleghany Mountains, and descend near the sea-coast of the United States.

"Upon the demonstration of these facts, which he knows he can do, he will make his ascension from the city of New York, with one of

Francis' life-boats as a car, supplied with water, provisions and six or eight attendants (having volunteers already), and will make a voyage across the Atlantic to Europe, and he trusts, should it please Providence to bestow upon him health and life, to stand before you in your hall, a living evidence of having made the first aërial voyage round the globe.

"The amount of money asked for this great and wonderful project is so small, when the ends to be accomplished are considered, and when compared with the immense expenditures of the government for the navy and army and for other purposes, that the petitioner humbly and confidently flatters himself that it may and will meet with a favorable consideration.

"In conclusion, your petitioner will refer with pride and pleasure to the fact that Fulton, the discoverer of the navigation of the ocean by steam, was also born in his native county, and he hopes and feels that he shall be the first to apply the navigation of the air to the usefulness of man, and demonstrate the practicability of aërial voyages round the globe. And your petitioner will humbly pray, etc.

"JOHN WISE."

The following debate took place in the Senate upon the presentation of the memorial by Mr. Douglas:

"Mr. Douglas.—I have received a letter from John Wise, of Lancaster, Pennsylvania, enclosing a memorial of an interesting character, which I have been requested to present, and move its reference to the proper committee. I am not prepared to say precisely what committee that would be.

"The memorialist states that he has devoted sixteen years of his life studiously to the science of aëronautics; that during that period he has made over a hundred aërial voyages successfully and with safety. He states, also, that he has written a work upon this science, in which he has given a history of it and an account of the developments of its principles, which has been received with great favor by the scientific world. He also states that he has demonstrated to his own satisfaction, and is prepared to demonstrate to the satisfaction of the world, his power to make the science useful and practicable for the transmission of mails and the transportation of passengers, and especially in the art of war as well as in peace. He also states that he is prepared now to construct a balloon 100 feet in diameter, which shall have the power of elevating 16 tons; that he is prepared to elevate that balloon over the Capitol, or President's house, or Navy Yard, or any other point which may be designated, above the reach of gun-shot, and then to discharge imitation missiles of a destructive quality, which would show his capacity to destroy fleet, fort or army which may be beneath it. He also proposes when he shall have done that, and shall have satisfied both

Houses of Congress and everybody who will attend his experiment that it is entirely practicable and within his control, to take that balloon to the city of St. Louis, and make a voyage thence to the city of New York. At New York he proposes to take in six other passengers, who have already volunteered, and a life-boat, and proceed to England, where he will report to the British government. He expresses entire confidence in his ability to do this with perfect safety; and, furthermore, that he can make a quicker voyage around the world with his balloon than in any other way; that his experiments have shown that at a certain elevation there is a current of air from west to east, in which he can sail with perfect safety, and with more expedition and velocity than by any other mode of conveyance. He desires the opportunity of testing this, and of satisfying the world of the truth of this theory. He says that he can make these experiments from St. Louis to New York and from New York to Europe for the sum of twenty thousand dollars. He thinks that this will enable him to fully demonstrate the practicability of this science, and its applicability to the purposes to which he proposes to devote it. He alludes to the fact that we are making very large appropriations for objects of much less utility; and inasmuch as he has devoted his life to this business, has made so many successful voyages, has written a book demonstrating the practicability of this science, and only needs this small pittance to carry his scientific discoveries into practical effect, he says we ought to give him that amount to allow him to make the trial, and enable him to be the first man that ever sailed around the world in a balloon.

"I present this memorial as he requests. I am assured that he is a man of great intelligence and scientific attainments. I have not the honor of knowing him, but these are the representations made to me by citizens of that State whom I know to be men that are entirely capable of judging of his qualifications in this respect. I hardly know to which committee I ought to move its reference. I am satisfied that it does not come fairly within the jurisdiction of the Committee on Territories. The chairman of the Committee on Public Lands insists that it is not within the jurisdiction of his committee. I am inclined to think that as it is evidently a rival project to one referred to the Committee on Roads and Canals—Mr. Whitney's railroad—it ought to go to that committee, that its objects may be considered. I have read this petition with much interest. It is written with a good deal of ability. I have looked into his book, though I have not had an opportunity of reading it, and the impressions which I have formed of it are favorable. He has drawings of all his machinery and the different modes of conveyance, got up at great expense and with great elegance; and I have really been very favorably impressed with the memorialist and his memorial. I move its reference to the Committee on Roads and Canals.

"Mr. Bright.—I do not wish, as a member or as chairman of that committee, to avoid any responsibility; but it seems to me that the prayer of the petitioner goes far beyond the jurisdiction of the Committee on Roads and Canals. It is proper for me to say that I do not favor visionary projects of this kind. I think it is the province of our committee to look to roads and canals on *terra firma;* but when it comes to navigating the air, the prayer does not find a friend in me. I think the Committee on Foreign Relations, if I may be permitted to suggest, would be more appropriate [laughter], for the duties of the committee lead them to the consideration of the affairs of foreign climes. I hope the gentleman will change his reference.

"Mr. Douglas.—I do not know any impropriety in the reference, and I will therefore move that it be referred to the Committee on Foreign Relations.

"Mr. Mangum.—Mr. President, as the chairman of that committee is not present, I feel it to be my duty to remark that we are very little learned in matters of this kind; but as I believe that the honorable Senator from Illinois has recently been made a member of that committee—

"The President.—The Senator was excused from service on that committee at his own request.

"Mr. Mangum.—Then I protest against its going to that committee; but as the honorable Senator from Illinois has indicated a high degree of scientific attainment in these matters, to the edification and amusement of the Senate, I think it should go to a select committee, and that he should be placed at the head of it.

"Mr. Douglas.—I think this subject should be treated seriously. The memorialist is undoubtedly a gentleman of high character and of scientific attainments, and I hope his memorial will go to one of the regular committees. It was transmitted to me by a naval gentleman, who suggested that it should be referred to the Committee on Naval Affairs. I move that it be referred to that committee.

"The motion was agreed to."

It is scarcely necessary to state that the Committee on Naval Affairs never made a report, and that I very speedily gave up all hope of obtaining assistance from Congress.

"THE TWO STORMS WERE NOW APPROACHING IN GRAND BATTLE ARRAY."

# CHAPTER XXXI.

A voyage from Portsmouth, Ohio, to Point Pleasant—Swallowed up by a storm-cloud—The nature of thunder-storms—The aureola—The safety of balloon travelling in a thunder-storm—The descent.

THE first time I was ever swallowed up in a storm-cloud, it happened to be in a suddenly generated hail-storm nimbus during an ascension from Carlisle, Pa., the particulars of which adventure are given in a previous chapter. A hail-storm is not a very large meteor, but it is very violent in its gyratory action; and when it sucks a balloon into its vortical air-hopper, the aëronaut may look out for a little rough usage, and not the least of his troubles will be a nausea similar to that of sea-sickness, following the swinging to and fro, compounded with gyrations, of the air-ship. I will, however, for the present, describe an experience of travelling inside of a thunder-gust for a distance of nearly a hundred miles along the Ohio River, in a balloon voyage from Portsmouth, Ohio, to Point Pleasant, about twelve miles below Gallipolis, on June 3, 1852. Straight across the country from Portsmouth to Gallipolis is not much over half the distance it is by the course of the river, but thunder-storms have a penchant to trail their watery drapery along river channels.

The ascension was made in the afternoon, between four and five o'clock, and right in the face of an approaching thunder-gust coming from the north-west. On attaining a height of three-quarters of a mile, I discovered a second thunder-gust coming along from the south-west. My balloon was situated on the apex of the two lines of the approaching storms, and already gave indications of a fear of being gobbled up in the vortex of centralizing air incident to storm-clouds. I made up my mind to go into the whale's belly, not entirely regardless of consequences; but being well provided with gas and ballast, I was consoled with the knowledge that I could escape from this agitation of the air by using the means of gravitation in letting out gas, or of levitation by disposing of ballast.

The two storms were now approaching, as it were, in grand battle array, with thundering explosions. The discharges of lightning came vivid, sharp and frequent; and when the two storms clashed, they be-

came terrific. It was a scene of awful grandeur. I had a mind to escape by one or the other of the means just mentioned, but, like Lot's wife, I was curious enough to look back—not to be turned into a pillar of salt, but certainly to be well shaken, hurled round and round, as it were, by the nape of the neck.

The intelligent reader may here be reminded that a thunder-storm is not an accidentally condensed, irregularly massed body of watery vapor, as viewed from the earth, but a geometrically formed and individualized meteor, and of mathematical precision in its motion and compensating balances. It is more or less governed in its onward progress by the undulations of the earth's surface—the channels of rivers, valleys and mountain gorges. These meteors take short turns to pass into a deep valley. When they happen to plunge against a mountain-side that lies in their direct course, they often become tangled in the mountain top, swaying to and fro like things of life, and this gives rise to those destructive mountain torrents known as "cloud-bursts." The rain that would be otherwise spread over a great surface is by this stand-still of the meteor poured down against the immediately underneath surface of the mountain side.

It requires no strained imagination to give interest to storm scenes as viewed from above them and in their midst; and when it is considered that a balloon is not in the predicament of a ship at sea in a storm, the scene may be viewed with an assurance of safety that is never realized on the water. The sea-ship has two elements to contend with. The air whirling it around in the vortex of a storm, and the thousand times denser water holding it in its embrace, brings upon the sea-ship a leverage and strain that crashes and cracks it to pieces. The balloon has but one element to contend with, and it matters not whether the current is one mile an hour or one hundred miles; to the air-passenger it is all the same, for he knows not that he is moving at all unless he can see some landmarks to give him an idea of motion. In a thunder-cloud, however, there is a perceptible motion, not violent, but disagreeable. The motion is gyratory—a swinging to and fro and going round in a circle at the same time—and this motion produces nausea like sea-sickness. The huge black precipice of nimbi, or the brilliantly illuminated lava-looking cumuli, have not the terror-giving character to the air-passenger that the coral reefs and leeshore rocks have to the sea-passenger. The reader is now better prepared to resume the thread of the narrative with composure, since dashing against an atmospheric boulder will not shock him.

These two storms merged into one, having met at an angle in the course of the river where it trends off from a south-west to a north-east direction of stream. The united storm followed the course of the Ohio up to the mouth of the Kanawha River, and there it made a turn up that watercourse. Sailing in this meteor, I was constantly surrounded

by electrical phenomena. While the discharges of lightning were almost incessant, thundering and crashing out of the thick vapor with livid, zigzag bolts darting down toward the earth, they never seemed to explode near to the balloon. Most of the time the balloon was sailing in clear atmosphere between the upper and lower clouds, though right in front of it, and within a few hundred yards, the upper and lower clouds were joined in the form of a water-spout, and from this conjoined mass the discharges were mainly taking place, though occasionally a more distant explosion would occur. The central explosions were so frequent and terrific that I dare not let the balloon rock into the vortex; and in order to avoid this, I had to pay out ballast and gas, causing the balloon to rise and fall, and by that means be thrown outward in the upper cloud, whenever the lower cloud had rocked too near the central uprising air-shower. This kind of manœuvring had been learned from former experience in these meteors.

One time the balloon got so far to the rear of the centre of the vortex between the upper and the lower cloud that it fell into the rays of the sun. This produced one of the rarest spectacles of rainbow light in the form of a parhelion, or aureola, as it is technically termed, that my eyes ever rested on. It threw upon this black central cloud matter a beautiful prismatic arch of vari-colored light, not circular as a rainbow, but in the form of a twisted ellipse, caused, no doubt, by the difference of density of the watery particles acting as the screen. I gazed upon it with admiration and amazement. All this time the celestial fireworks continued in full blast, banging and booming like great guns, and the hissing of electrical streams of fire was truly appalling. It seemed to me like the crack of doom; and while it made my hair bristle and my heart beat quick time, it seemed still to say, "Stand from under," because the thunderbolts were all hurled downward. So far as my reason could direct, I felt it safer to look at it from above than from below; besides, the country below was mainly forest and river, as seen from an occasional glimpse through an open chasm of the lower cloud.

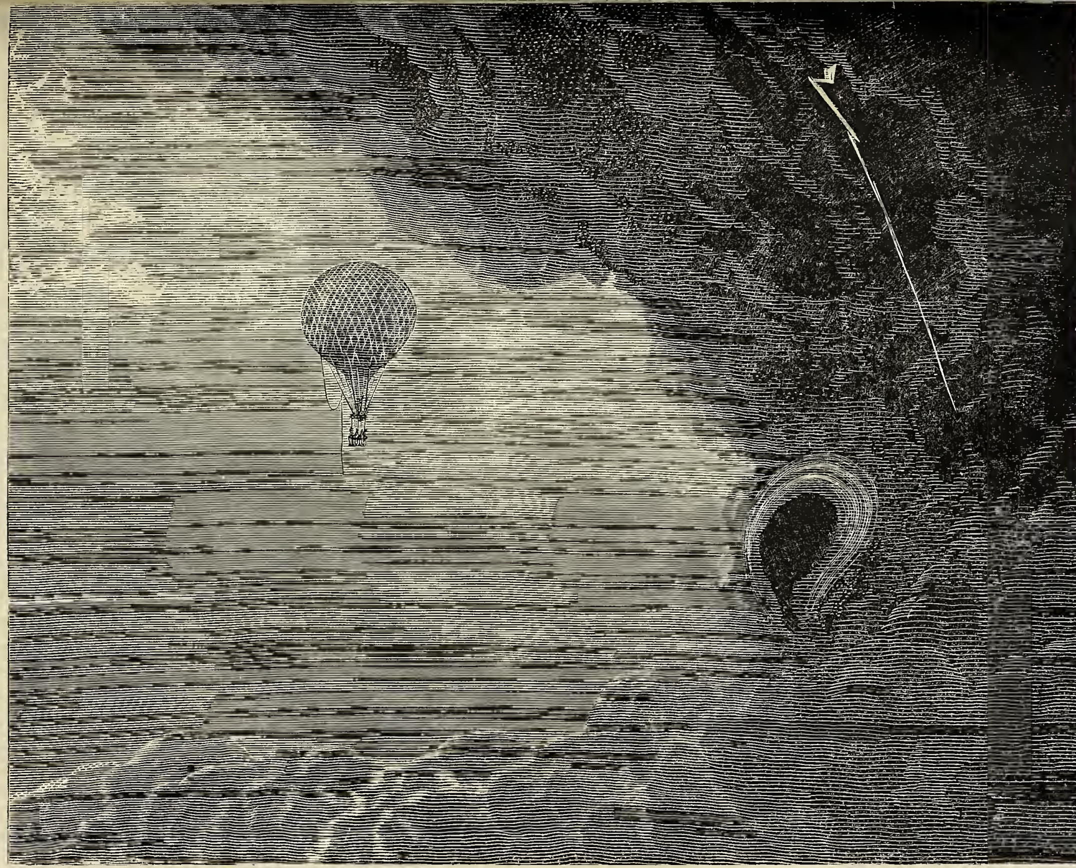
Once the balloon was totally involved in a mass of orange-colored flame. This was evidently "sheet-lightning" playing between the upper and the lower cloud. I was for a moment paralyzed, not by an electric shock, but by a shudder of fright, as it seemed for the moment that my air-bubble was in a blaze. In an instant more I felt easier in mind, seeing that the fire had not harmed the balloon. The thought now occurred, "Am I not venturing too far upon my philosophy of safety in a thunder-cloud?" Besides, my ballast was pretty well exhausted, and I had been riding in a storm for more than an hour, so that I must be many miles from the place of departure.

The beautiful grotto of fire would appear and disappear as the balloon happened to fall in and out of the sunbeams blazing in between the upper and the lower cloud. The balloon refracting the

rays of light passing through it caused the prismatic arch. The rain was discharged from the lower cloud, and occasionally a few heavy drops would fall on the balloon from the upper stratum. From the rushing noise of water, it was evident that the rain was descending to the earth in torrents, and this, with the heavy and constant discharges of thunderbolts and the remarkable beauty of the aureola illuminating the interior of the storm-cloud, gave it more the character of a scene of enchantment than one of reality. There was a fearful fascination in the grand phenomenon; and while it made one's heart beat with emotion and a feeling of awe, it still persisted in dragging one along as the soldier is dragged along in the thick smoke of the battle's cannon. It is impossible to fully and fairly portray with words the condition of mind and its surrounding phenomena when sailing in the midst of a good-sized thunder-storm. It is a sublimity not realizable on the surface of the earth, grand and majestic as these meteors present themselves to an observer on terra firma.

Having now sailed within the folds of this electrical meteor for over an hour, and for a distance of nearly a hundred miles by the course of the Ohio River, and viewed it from various positions, the limited amount of ballast remaining on hand admonished a preparation for descent. Before coming down, a dozen or more copies of the Portsmouth daily paper were thrown overboard, and they were soon drawn into the vortex of the storm. One of them fell into my hands again the next day, as will be explained in the conclusion of this narrative. I now commenced to descend slowly and cautiously, in order to look out for a safe landing-place. As this process was going on, the storm was moving forward and away from the balloon. On coming down through the lower cloud I found the surface of Gallia county hereabouts covered with forest; but some distance ahead in my line of direction a log cabin peered out from a little "clearing," and I struck for this and made a lodgment before the cabin door in the rain, greatly to the surprise of the family in the house. Seeing the suddenly-appearing apparition was nothing more than flesh and blood, the good housewife cautiously, with the door slightly ajar, ventured the question of "Who are you?" In dripping garments and with the most gentle speech at my command, I answered, "A stranger, madam, in a strange land; will you please help me a little?" Still holding the door in her hand, she said, "What is that?" pointing at the air-craft as it was swaying over her head. "A balloon, madam, just come out of that cloud." The door immediately flew open and at the same time she exclaimed, "Come out, Joe; here's a man in a balloon that you read about in the paper the other day."

The next morning I went to Small's Landing, a few miles off, to get on a Pittsburg and Cincinnati packet to return to Portsmouth, and there I found one of the papers referred to above, and which they told me had fallen down from a black thunder-cloud that passed overhead the



"I GAZED UPON IT WITH ADMIRATION AND AMAZEMENT."

day before, much to their astonishment until I had explained to them by what kind of an express it had been carried to the distance of ninety miles two hours after it came from the press.

There are scenes in our lives that seem to become as indelibly impressed upon the tablet of the brain as is the image on the photographer's albuminoid membrane, and these storm scenes are of that character. The secret majesty of nature therein asserts its superior divinity, and makes man shrink into the insignificance of a microscopic monad, with all his boasted intellectual powers, when compared to the intelligence of the greater Ruler of the universe.

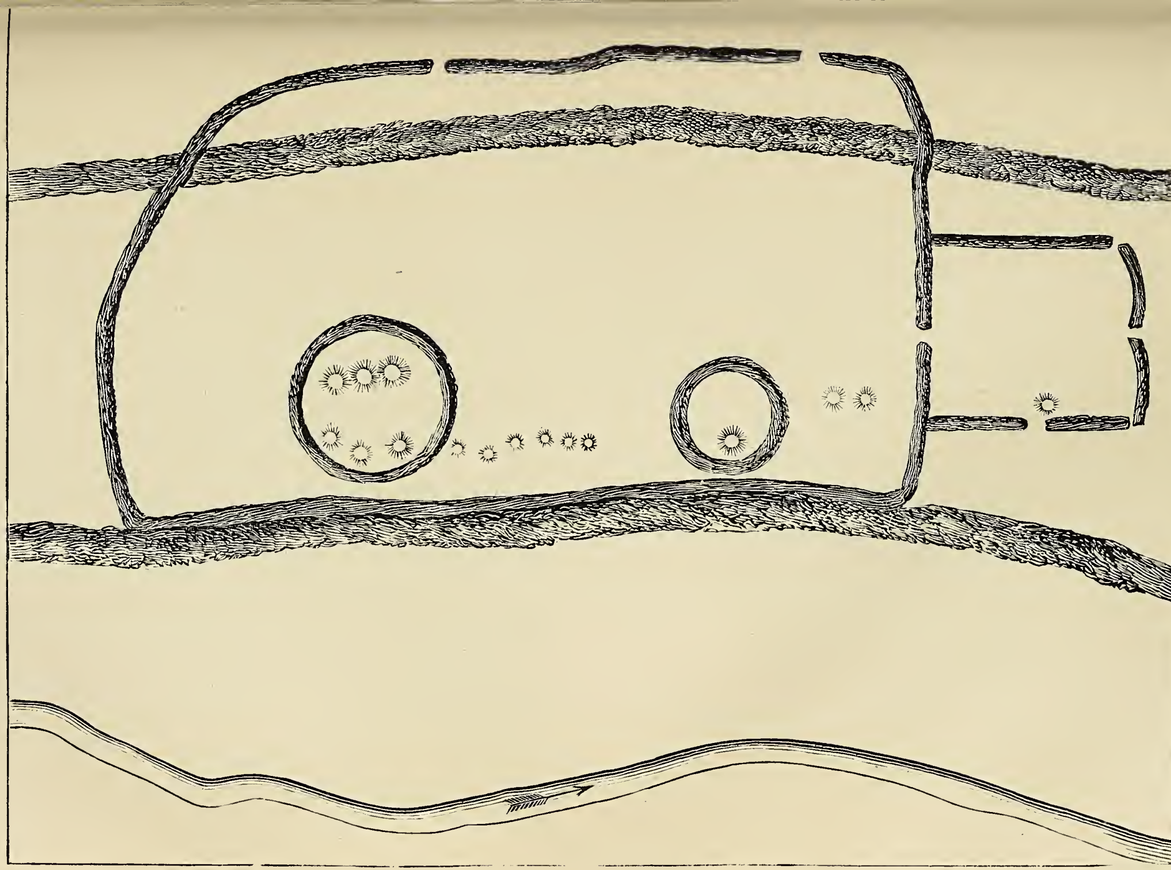
# CHAPTER XXXII.

Ascent from Chillicothe, Ohio—Wabbling motion of the balloon—Curious figures on the ground—Relics of a pre-historic age.

MY one hundred and thirty-second aërial trip was made June 10, 1852, from Chillicothe, Ohio. The following narrative was furnished to one of the daily papers:

"The large and very respectable audience who honored my ascension with their presence and generosity yesterday afternoon will probably look for a description of the trip, since it has been almost a universal custom with me to write one, short as the voyage may have been. I was aloft 45 minutes, and attained a height of about one mile. Although I had not intended, from the beginning, to make a long voyage, owing to the Circleville ascension coming so closely after this, I had, nevertheless, intended to go at least two miles high, and sail completely out of sight; but on account of the disorder in which I found my car rigging when I got aloft, the lower hoop sliding out of its place, leaving me no support for a hand hold, and the upper hoop being twisted in the ropes, throwing the whole machine out of trim, it was very uncomfortable to ride, as it kept the balloon in a wabbling motion all the time, and in encountering the eddies and counter currents above, it became almost impossible for me to sustain the centre of gravity. I have frequently ascended without the car, merely sitting in the main cords, and rode much more comfortably than yesterday.

"The view of the country transcended my most magnified idea. There was a richness, a fruitfulness, a grandeur and natural glory in the landscape around and about the city of Chillicothe that has fairly surpassed any other that I have ever seen. Casting my eye distinctly over the city, the prospect was suddenly marred; and had I not known beforehand what caused it, I should most certainly have wondered what it could be. There was a desolate spot in this rural city; it had a mournful appearance; it caused my mind to run upon the historic ruins of Tyre and Sidon and of Jerusalem. I felt deeply for the unfortunate inhabitants who have been driven out of their homes. Thus my mind ran for a while; but taking a grand review of the vast plain beneath,



ANCIENT EARTH-WORKS AT CHILLICOTHE.

embracing a country of 50 miles each way, its fertility, its resources and natural beauty, the calamity which I had just pondered over seemed but like a slight ordeal, a trial of moral obligation and responsibility of this favored city's enterprise, for surely the God of nature has specially planted every necessary advantage around it, in an admirable and inviting manner, to provide for its safety against the contingency of the devouring element.

"I noticed over a dozen towns in view—large towns, seemingly; but my eyes once arrested by a sight between the city and the river, I could not remove them for the balance of my short trip. On the plat near the river I noticed some mathematical figures which seemed to be printed in the soil—for the ground seemed to be well cultivated—of many acres in extent, that puzzled my imagination for the time. Could it be a delusion? No, I was only moderately high then—3000 feet. I viewed it and reviewed it, and it must be in the soil, if it is not actually a raised line in the form of a bank over the general level. On my return home I learned of the citizens that there are traces of ancient fortifications thereabout, and this at once revealed the mystery. The most conspicuous of the figures somewhat resembled a rude sketch of the upper part of the human body, and the lower part the shape of a sickle. The aspect of the figures, as viewed from above, had much the characteristic features of the hieroglyphics found upon the ancient monuments of Egypt.

"The appearance of these outlines in the soil shows how the power of vision is increased by looking down upon the earth from balloon height. I made it a point to go over the ground where these figures appeared, but could trace no outlines, although what I saw from above must have been the result of color in the soil. It is not an uncommon thing to notice this remarkable phenomenon of vision when sailing over the earth. While one is on the earth it is impossible to take within the range of the eye a large area at one glance. When up in the air four or five thousand feet, of a clear day, you can take into view at a single glance many square miles, and hence the faintest outlines in the soil, such as I have noticed, fall within the compass of the eye as a whole, and make a very vivid impression, while you might walk over the same space a number of times, and never suspect that such outlined figures existed underneath your feet. Sometimes the outlines of underlying stratifications are rendered visible to the eye of the aëronaut. The bottoms of lakes and rivers are very distinctly delineated when the water is calm and the atmosphere clear. The cut gives the ancient earthwork near Chillicothe, as made out by actual surveys. Of course, as I saw it, the outlines were to some extent obscured and broken by different objects, which made me think that it resembled, to a degree, the human figure."

## CHAPTER XXXIII.

Ascent from Lancaster, Ohio—Hollow appearance of the plain—Magnificent view—Ascent from Mansfield, Ohio—A curious cloud-curtain—Ascent from Massillon, Ohio—Electrical condition of the atmosphere—Clouds as sounding-boards.

ON June 24th, 1852, I made a very interesting ascent from Lancaster, Ohio. At fifteen minutes past four P. M., the last cord that restrained the restless air-ship "Ulysses" was sundered, and after making a few bounds with an apparent attachment to old mother Earth, ascended with majestic stride into the realms above. As she rose swiftly and smoothly, the towering hill-tops that adorn the surrounding scenery of Lancaster sank quickly and majestically into the general level. For a few minutes the vast area so magnificently dotted and variegated with nature's richest tints presented a great circular plain bounded all round by a horizon of immense piles of clouds. This view accorded beautifully with the old Ptolemaic theory of the planisphere; but by the time an altitude of 8000 feet was attained the vast plain assumed a hollow appearance; immediately underneath the car objects looked to be at an immense depth, but off and approaching the horizon they appeared to gradually rise, the furthermost, being from forty to fifty miles off, rising to a level with the eye.

Fifteen minutes after my departure the prospect was most grand and extensive; being at an altitude of about 4000 feet, there were brought into view many towns and cities. Columbus, Zanesville, Circleville, Newark, Chillicothe, Logan and innumerable little villages garnished the splendid panorama. The rich fields of wheat tinged with various hues, the "blue-stem" and "white blue-stem," the golden-headed "Mediterranean," the heavy-topped "beard wheat,"—all these waving in the bright sunshine beneath, blending their golden tinges with the rich velvet green of the stately forest trees patched between them in squares and polygons, produced one of the grandest pictures that mortal eyes can rest upon.

The canal, reflecting the bright rays of the sun, shone like a silver telegraph wire, was strung wave-like over the landscape. To the north, a beautiful little lake, with a romantic little island, formed a pleasing and enchanting prospect; water is a characteristic feature of embellish-

ment in topographical scenery. To the east, between me and Zanesville, a cluster of buildings appeared to stand on precipitous rocks, the sun shining against them giving the scene a very unique appearance. Indeed, the whole scene presented a very vivid appearance.

The atmosphere was remarkably transparent, and the clouds, where I got above them, reflected a heat and brilliancy of light that was really painful at times. Thirty minutes after my departure a thin filmy cloud hung like a gossamer curtain between me and Lancaster, and the city had the appearance of floating on a lake of blue vapor; but as I rose above the cloud, Lancaster again resumed its terrestrial foundation.

Having now got about twelve miles to the south-east, and knowing that thousands of eyes were still watching the small speck above the eastern horizon, and having notified many that I would not go far, I now commenced a rapid descent. As I lowered to within hailing distance, the last four miles of my voyage, loud and frequent were the salutations that reached my ears. Some enthusiastic mortal cried aloud, "Oh, you look like Gabriel." Another, with a fainter strain, cried, "Come down! come down! for God's sake, come down!"

My continued answers to the appeal from below seemed all the while to increase the infection, and before I finally landed I found I had hallooed myself hoarse in responding to the animated people who cheered me during this part of the voyage.

At five minutes past five I landed on a green field, owned by Mr. William Bowlin, Marion township, Hocking county, sixteen miles from Lancaster.

On July 17th of the same year I started from Mansfield, Ohio, with the air-ship "Ulysses," at 4 o'clock P. M., with a brisk breeze from the north. The current of air near the earth moved with a velocity of at least 30 miles per hour. This rendered the appearance of the ascent rather slow at first, because the perpendicular motion of the balloon was not so rapid as its horizontal. At an elevation of 2000 feet this current began to grow weaker, which altitude was gained about a mile from the starting-point, after which the ascent became rapid and the southward motion slower.

At eighteen minutes after four I crossed a village, the "Ulysses" having then attained an altitude of 4000 feet, and was still rapidly ascending, the inhabitants below sending up shouts and huzzas as she passed along. I returned the salutes by waving my flag. At half-past four I crossed another town, in which the inhabitants seemed alive to the flight of the air-ship, and the whole country around was reverberating with the shouts and huzzas of approbation of the "air line" passing over them.

An altitude of 8000 feet was now attained, and the grand panorama was fairly spread out beneath in all its multitudinous glory. To the north-east of Mansfield a beautiful little lake embellished the landscape

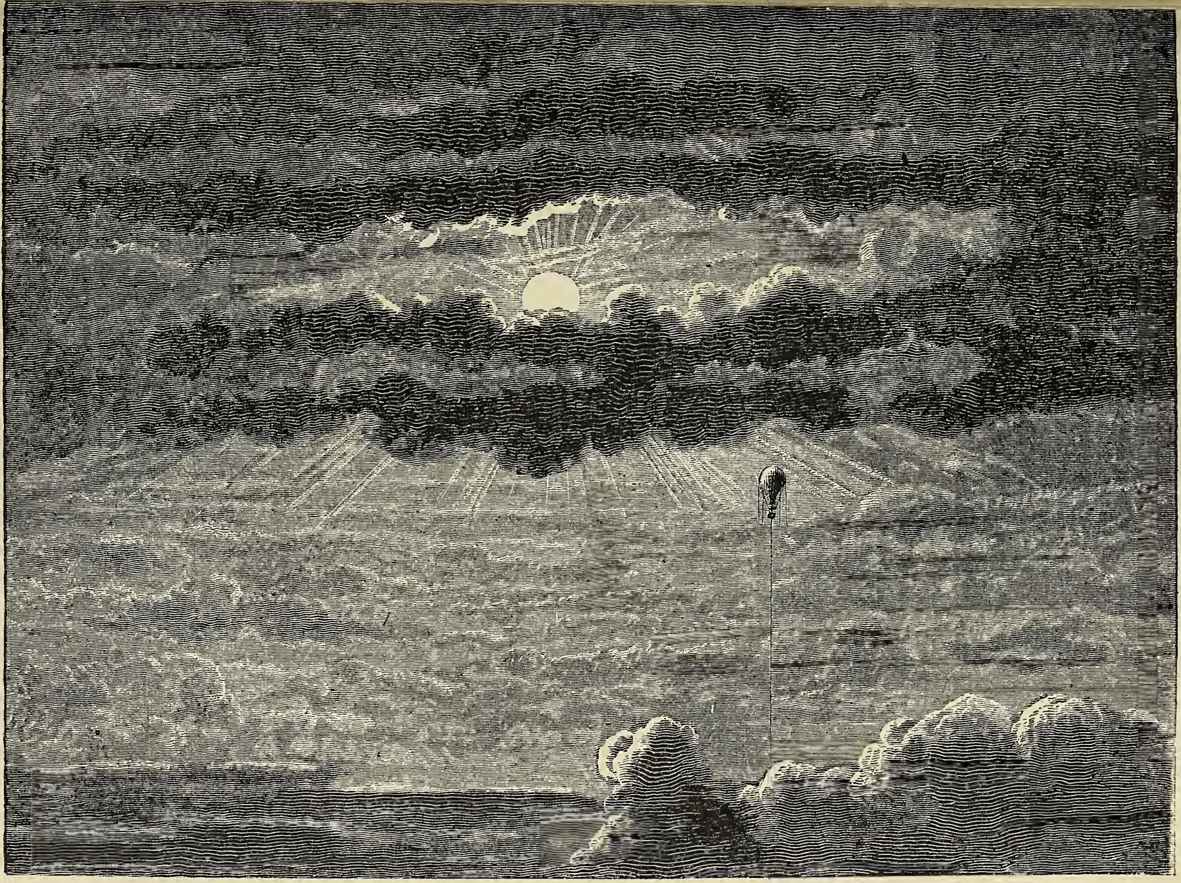
immediately around; to the north, Lake Erie shed its brilliant reflection like a great sheet of polished silver, and the vast area far and wide was dotted with plantations and woods, villages and cities, the domes of some glittering in the sunbeams beneath like brilliant stars. Mt. Vernon was the handsomest city in the plain; it stood out as the most prominent feature on the great chess-board beneath. Mansfield was conspicuous from the cloud of dust hovering over it, caused by the mass of vehicles constantly in motion in and about it.

The whole circumference of the heavens was hung with a cloud-curtain of a peculiar cast, its lower edge smooth and regularly defined, the upper presenting a variety of scallops and projections, which rendered it most picturesque and beautiful; it was a most beautiful cornice around the interior of an immense rotunda.

At five an altitude of 11,000 feet was attained. The atmosphere at this height was pleasantly cool. The "Ulysses" was now distended to her most pompous dimensions, smoking at the mouth like an overcharged steamer, and the rarefied condition of the atmosphere discommoded my ears to an unpleasant degree by a humming noise that always ensues under similar circumstances.

I was now hovering nearly over Fredericktown; presently I heard the whistle of the railroad train coming up toward the village, and as it emerged from the foliage which at first obscured it from sight, it looked like an anaconda with a black head dragging itself along the ground. The train stopped ten minutes and then piped up the road again, apparently making more noise than speed. All this time the patriotic people of Fredericktown were saluting the arrival of the "Ulysses" by the firing of cannon, which I returned by waving the star-spangled banner over them. I wished at the time for a good six-pounder to return the salute in right good earnest.

Having now determined to make a descent as near Mt. Vernon as possible, my attention, for the last time, was drawn over the grand scenery below; but as I took a full and general prospect of the world, I calmly laid down my pencil and book, and exclaimed, in heartfelt reverence, "Great and wonderful are thy works, O God!" and as I pondered over the scene, my mind was naturally enough led to the contemplation of how vast the mind and power of the Deity must be. Before these thoughts entered my mind I felt exalted to a high degree—everything around, below, above me the swollen "Ulysses," conspired to such an effect; but in a serious contemplation, a few moments thereafter, of the magnitude and power of God, how humbled, how insignificantly small, I felt! Being down mentally, I soon began to come down physically; I felt as though I had stultified myself beyond my deserts, when I reflected upon the fact of how small an atom my whole paraphernalia must be in the great work of nature. At forty minutes past five I landed on the Delaware road, a few rods from the house of Mr. Wm.



"ALL WERE DISPLAYED IN GORGEOUS GRANDEUR."

Myers, five miles west of Mt. Vernon, who immediately tendered me his assistance and the hospitality of his house.

On the 31st of July, 1852, I ascended from Massillon, Ohio. The ascent was made at fifteen minutes before four P. M., with a strong north breeze. At the height of a mile the wind came from the north-west. At the height of a mile and a half it was strong from the west. At the height of two to two and a half miles it was from the west-south-west. This brought me up in the track of a semicircle to within three miles of Canton, to the south-east of it. Here I lowered into the current blowing directly from the west, and pursued for a while the even tenor of its course eastward, making headway at the rate of a mile per minute and a half. As I was sailing away from Canton, a large body of cloud which was sailing southward obscured the whole town from my sight as long as the vapory curtain hung over it.

At this point the view was ample and grand beyond the power of description, Lake Erie glittering in the north, and the beautiful Ohio developing its silvery folds bulged up above the horizon in the east. Several beautiful small lakes also garnished the immediate northern landscape.

The clouds now began to thicken underneath, with openings here and there through which the towns and watercourses peeped occasionally. Soon this flock of clouds passed to the south, which left me an ample and open field of view. A hundred towns and villages now sprung into view; the atmosphere was pure; steeples and domes were glittering in the sunbeams all around. The north-eastern part of Ohio looked like one vast city with suburbs. Now again an immense field of clouds appeared below, eclipsing again terra firma, and almost rivalling it in grandeur. These formed an aërial world; the clouds were of all imaginable shapes and forms, representing mountains and valleys, reefs and precipices; all were displayed in gorgeous grandeur. The atmosphere was cold, the thermometer standing at thirty-three degrees, and I began to button up my great-coat to the chin. Presently I was startled by the whistle of an engine apparently close by. It seemed to proceed from a point not more than a hundred feet off, which, upon inspection, I judged was caused by a dense cloud immediately below. There was also an army of thistle parachutes sailing their seed cargoes to some distant soil, no doubt fulfilling an inscrutable destiny of nature's law. The atmosphere seemed highly electrified; the sand, as well as other substances which were thrown overboard from time to time, vibrated between the car and balloon more than usual, and the slightest touch upon the net-cords caused them to send forth intonations of melody and heavenly music. While I was contemplating a trip to the Ohio River, my attention was directed toward a body of cloud of different color and form from any that had passed during the voyage. It was a large, flat bed, of an ashen color, and was considerably higher than any of the

variform cumulus clouds. I lowered to pass through its hinder edge, and from all points that I viewed it it had the ashen color, and the air was chilling cold in and under it, but it gave out no water in any form that could be seen. The other clouds had the appearance of dense steam, and they were floating at very different elevations, varying more than two thousand feet in their altitudes. While in the clouds I could hear persons conversing several times on the earth. Clouds seem to be very good sounding-boards. I experienced none of the effects related by Mr. Petin, concerning his voyage from Bridgeport, a short time before, as regards the effects of voice, of strength and of sleep. With me the voice was audible and loud, my strength was more than adequate to pull the valve—yes, sufficient to have pulled the top off the balloon, if required—and so far from inclining to sleep, my sensations were of a wide-awake nature, as they always are in aërial voyages. At five o'clock I descended four miles south of Minerva, thirty miles from Massillon, the balloon having made a track in the form of the letter S, and travelled at least forty-five miles.

## CHAPTER XXXIV.

Ascent from Akron, Ohio—Peculiar topography of Ohio in the neighborhood of Akron—Ascent from Detroit—The lake district as seen from a balloon—A poetical tribute to the air sailor.

THE topography of some portions of the State of Ohio is very peculiar and exceedingly interesting as seen from a balloon. During my one hundred and fortieth air voyage, which was made from the town of Akron, in August, 1852, the country presented a very peculiar appearance.

Before starting on my aërial trip, the audience expressed a wish that I should make a descent close by, provided an altitude could be attained sufficient to make a rapid descent interesting.

At an elevation of 6000 feet I commenced a rapid descent, increasing its velocity until a point 1000 feet above the earth was reached; finding then that the proposed place of landing was not a desirable spot, ballast enough was disposed of to bring the air-ship to a stand about 300 feet above the surface of the earth. Many persons ran to this point, who rather viewed the second ascent with disappointed feelings, having evidently come up to catch the balloon. They, however, gave me a parting salute, some, the while, accusing me of having fooled them, inasmuch as I did not quite land. I assured them to the contrary, and thanked them kindly for their friendly feelings.

As the "Ulysses" rose the second time, having now turned my whole attention to the scenery around, the world disclosed myriads of beautiful objects. Akron, with its surrounding scenery, seemed as though it grew spontaneously and rapidly out of the earth, whilst the country immediately underneath appeared to be sinking away deeper and deeper as the balloon rose. A scene of grand perspective was now presented which it would be folly for me to attempt a fair description of. The long straight lines bounding the townships, peculiar to the topography of Ohio, converging in the distant horizon, gave the vast surface below the appearance of a great city, the township centres looking like squares and prominent spots in the great rural thoroughfare. Lake Erie lay quietly with its glossy surface in the northern vista, its bright breast

marred in several spots by smoke from steamboats. The many little ponds and lakes beautifully dotting the landscape around had the appearance of so many nostrils to the great pond in the north.

The view was a little concave, having attained an altitude at which all the irregularities of the earth's surface are lost to the eye of the aëronaut, Lake Erie and the Ohio River forming conspicuous objects on the outer border of the view. These waters appeared bulged up above the general level.

This parallelism of the topographical metes and bounds of this part of Ohio gave it a remarkably classic and artistic appearance such as I had never seen the like of before.

After viewing the great landscape over and over again, my eye fell upon a fairy-like carriage flying along below, pursuing a road running parallel with my route. Seeing the liliputian friend was in hurried pursuit of the air-ship above, I made a sudden descent a short distance beyond the village of Tallmadge, five or six miles from Akron, much to the delight of the people in the neighborhood.

On the 21st of August, 1852, I ascended in the balloon "Ulysses," from Detroit, Michigan. The air-ship was detached from terra firma at five minutes past four P. M. Having started with a strong ascending power, the lower current, which was from the north-east, was soon surmounted, and at the height of a mile and a quarter the wind came from the south-east. This current took me to the north-west, until a height of one and three-quarter miles was attained, and there the current from the west prevailed, taking me back near the city for a few moments and until I lowered from it, as I wished to pursue my voyage westward.

The prospect was surpassingly grand; from this point Detroit looked like a magnificent map handsomely illustrated, and the surrounding waters were marked with white specks of sailing craft.

Lake St. Clair and Lake Erie appeared to be but a few hundred rods apart. The whole of St. Clair was visible, and on the middle of the lake rested a pyramidical pile of cloud richly illuminated. Turning my observations westward, the eye passed over a splendid country richly studded with farms and villages. Some distance westward a dazzling cluster of spots shone with a peculiar splendor, rendering it difficult to survey for a while the real nature of the scene. It reminded me of a telescopic view of the moon. As the region was neared, I found it contained an innumerable cluster of lakes, which I attempted to count; but stopping at thirty-seven, I took it for granted the number could not be short of a hundred. They were of various hues—white, green and black; this must have been owing to the nature of their bottoms and their depths. Judging from the number of fields that encompassed some, they were two or three miles in diameter, while some contained about as many acres. Some also had beautiful little islands in the middle. Taking it all in all, it was the most beautiful sight I ever beheld, and it

is utterly impossible for the people who inhabit this region to conceive the real grandeur of their territory.

When I got as far north-west as Pontiac, or rather when I had sailed about twenty-five miles with the upper current, I came down into the lower one, which took me south of east, and in this current I sailed at a height varying from a quarter to half a mile, so that I could converse with people in passing along. In this current I sailed about twenty-five miles farther, and the people below were aroused far and wide, asking where I came from and whither I was going. I invariably told them I came from Detroit, and was merely exploring the country and the lakes. Now and then I was furnished with an animated equestrian scene, but I always got the lead of the pursuer, as the "Ulysses" was making in this current a mile in one and three-quarter minutes; this I ascertained by inquiring the distance from one point to another.

I got many kind invitations to come down; but as I did not come down for a while, some took it for granted I could not, but was destined to wander in the fields of space. At all events, I could understand that they sympathized for my not being able to descend, and before I could relieve them from this mistake I would be so far off, and engaged in conversation with new acquaintances, that it was quite impossible to enter into details.

At six o'clock I landed in Highland township, section thirty-three, Oakland county, the first twenty-five miles of the voyage having occupied one hour and fifteen minutes, and the last twenty-five miles but forty minutes. The point where I landed is forty-two miles from Detroit by a direct route.

The following poetical tribute to the air sailor belongs to this period of my career, and may be appropriately inserted here:

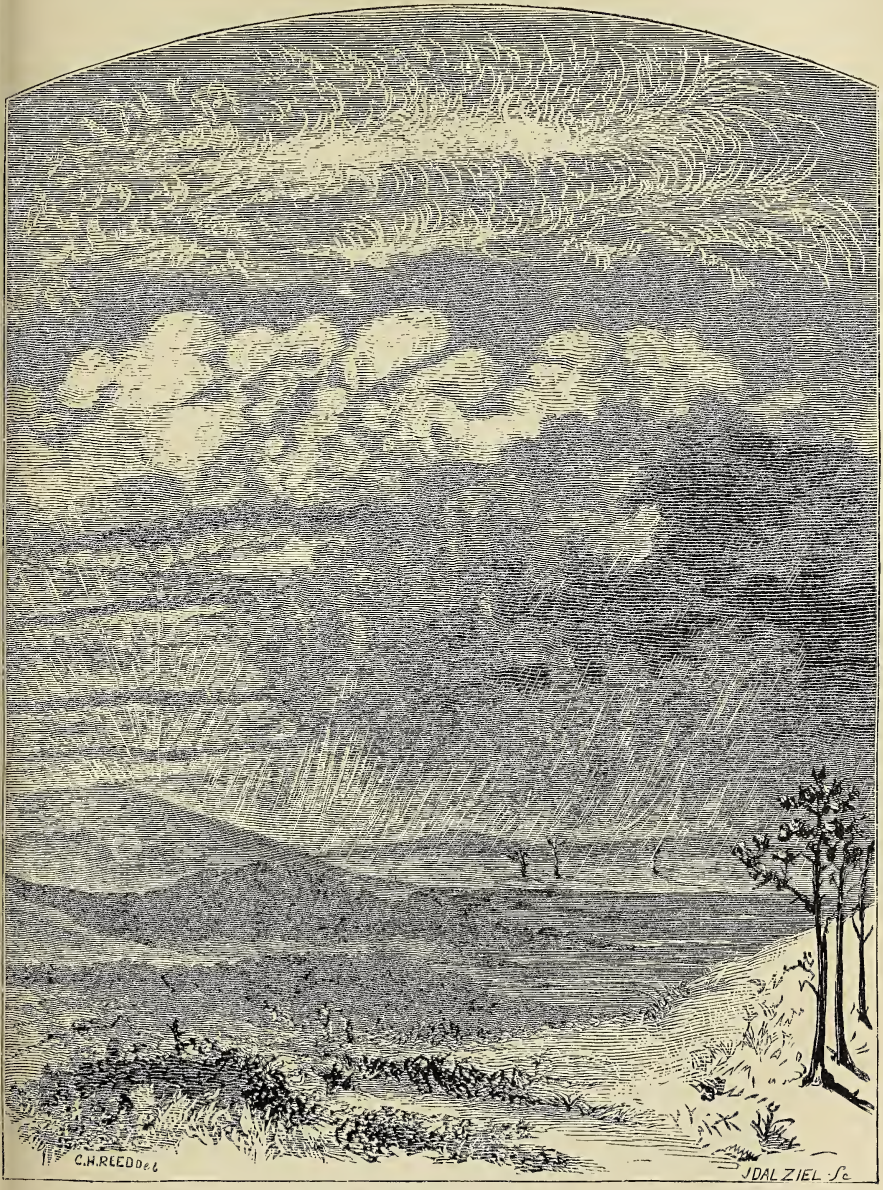
### TO MR. J. WISE, "THE AËRONAUT."

BY MISS S. S. BUTTON.

In days of old, ere man so *wise* had grown,
Ere Science such a flood of light had poured
(E'en when such things as "air-ships" were unknown),
No disenfranchised spirit upward soared,
Save when a flaming chariot was sent
E'en from inside heaven's glittering battlement,
Or when some angel bands the spirit bore
Up higher, e'en through heaven's pearly door!
  But in this later day fair Science hath designed,
And Art, with pliant fingers, hath combined
With wondrous skill, such gases as unite
To bear the silken ship and man from sight;
And like an eaglet, taught on mountain heights
To plume its wing, "Ulysses" now invites

Our wondering gaze, till, soaring up so high,
We fancy that her home is in the sky.
I'm sure I know not whether man would fly
To search out or to solve some mystery,
Did not the atmosphere forbid his rise,
Like flaming sword that guarded paradise.
Ah! were it mine to thus high upward soar,
Above the mountain heights and ocean's shore,
Methinks, as thus from earth I loosed my hold,
I'd almost feel my spirit's wing unfold,
To plume itself for immortality,
While swift I soared up through immensity.
But tell me, pray, fearless adventurer,
What hear'st thou in the clime of sun and star?
Is not the "spirit's harp" to music tuned
Amid the clouds? Doth not each varied sound
Seem like some heavenly note from seraph's lyre,
Or rustling of some spirit's wing that soars far higher?
Or angel's footfall on the golden floor
Of New Jerusalem? Doth not heaven's pearly door
Seem to unfold, while thou art up so high?
And seest thou not, e'en with thy spirit's eye,
A glittering company of harpers there,
Who heaven's most sweet, its full fruition share?
And when thou earthward comest once again,
Doth not thy spirit hear some gentle strain
From loved ones who would grieve with thee to part?
And e'en when the soul longs to fly above,
Yea, even when the spirit's almost gone,
It seems to be called back by such a tone.
Heaven grant that when for aye thou hence depart,
The voices of friends dearest to thy heart
May fall on thy ear—may they watch thy life's last ray—
Then may thy spirit rise to endless day!

Franklin Mills, Ohio, Sept. 19, 1852.




THE DIFFERENT KINDS OF CLOUDS.

# CHAPTER XXXV.

Clouds—Their classification—The characteristics of different kinds of clouds—Cloud formations.

CLOUDS are to the atmosphere as the foam is to the ocean. When the sea heaves and throbs and foams, it prognoses the pulsation of a healthful and vigorous constitution; and when the atmosphere exhales its misty zephyrs in the form of clouds, it simply indicates that nature is breathing the breath of life and health. Should the sea cease to roll and foam, and the atmosphere stand still, desolation and death would walk through the land and the water.

The clouds have been classified, not because one kind of cloud is made of different stuff from the other, but because, as Howard, their godfather, supposed, they consisted of four different species, and that each kind assumed peculiar shape and form, and he named them accordingly. First above us we find the nimbus, or storm-clouds; second, the cumulus, a dome-shaped cloud; third, the stratus, a bank or ledge-shaped cloud; and fourth, the cirrus, a horsetail-shaped cloud. The nimbus cloud springs up suddenly in a clear sky, beginning with a mere speck of vapor; but sometimes it is the result of a combination of its congeners, the cumuli. However it may take form, it always increases its dimensions very rapidly, spreading out in its circumference, with a pushing downward of its outer ragged edges. It is of a dark, leaden color at its base and as white as the driven snow on its top. It is shaped somewhat like a cabbage-stalk—puffed out at the top, contracted in the middle, and its root or lower part sometimes expanded, but not always; this depends upon the rapidity of its formation. When suddenly formed, it is the waterspout over the land. As a spout, it has no expanded base, but only a long trunk, much like an elephant's, pending from its body. When it gives out rain, this trunk-like appendage becomes obscured, since it is at best only a slight atmospheric coloring. I have seen such a trunk hanging down from the body of the cloud several thousand feet, and then the first large drops of rain that were driven against the side of my balloon scintillated sparks of fire.

The nimbus is the cloud that produces rain, hail, snow, lightning and thunder. Next comes the cumulus. This is a beauty of the sky. It

rolls and unrolls itself in the most voluptuous grandeur. Silver and golden-edged is its apparel. I have seen a grand army of cumuli formed over Niagara Falls on a hot summer day, and then taking their line of march along the highway of heaven, borne, fairy-like, from this frothy bubble, only to melt away into thin air on the wayside. Niagara is a cloud-making laboratory. Over the grand prairie of Indiana I have seen the atmosphere filled with innumerable dome-shaped cumuli during a hot day, it being very warm in the midst of these misty mounds, though the barometer ranged them two miles high. They appeared to cover the whole field of the prairie, and they all stood upon a perfectly horizontal level. The scene was indescribably grand. While occupying a clear space between them, they seemed to form a regular cluster all around as far as the eye could reach. Their horizontal arrangement was, no doubt, the effect from the prairie level below them. Light, fluttering winds were playing around them, and the buzz-flies were humming around my car. These probably took passage with me from the earth, and became animated from the genial warmth of these aërial castles. Much could be said of the ever-varying beauty of the cumuli, although, like the rainbow, they seem to be mere color-bearers or chameleons of the skies.

Next comes the stratus or bank-shaped cloud. This is a dull, ashen-colored layer of fog, with a body similar to the tail of a comet. While it presents considerable density in appearance from a distant view, it is next to nothing when you get into it. The stratus is a sluggard, and never bears any motion. Born of inanition, it dissolves without a struggle. The stratus has one peculiarity that is interesting. When it is very transparent and attenuated, it produces the phenomenon of mirage, and at such times the landscape of the earth below is thrown upon this misty screen, so that one sees the houses and trees and views above him as distinctly defined to the eye as are the real objects below.

Next comes the cirrus, the uppermost cloud of all. High above the possibility of human ascent stands this gossamer meteor. Frescoed against the ceiling of the sky, in beautiful curls and scrolls, this fairy queen of the heavens finds its abode. The French philosophers say it is a frozen cloud; but as I have never yet been able to lay hands on one of them, I am not prepared to verify the assumption. Sometimes, but rarely, the whole visible dome of heaven is filled with cirri, and above them the sky is intensely blue. Why they have at such times the peculiar form of a mare's tail, it is not given us to know, although it must be in accordance with the fixed laws of nature. When the cumuli and cirri are blended in the same range of view, it gives rise to what is termed a mackerel sky. I have seen this kind of cloud stratum a mile above the upper surface of a nimbus layer, with a clear sky between, and to an extent all round beyond the range of vision.

There is this peculiarity in the upper cloud surface: it takes the shape of the earth's surface beneath it. Hill and dale are well deline-

ated in the upper cloud-range. Over a mountainous country it becomes most picturesque, since the projections and defiles of the cloud-land are richly garnished with prismatic colors. These heavenly landscapes, with their richly-emblazoned edifices and towers, their fairy grottoes and rivers as it were of molten silver and gold, their vast defiles and projections, are beautiful beyond the power of description. The surface of the earth and the surface of the sea are monotonous in comparison to cloud-land. While the former is fixed, the latter is constantly changing. The nimbus may be seen jutting up above the common level several hundred feet in a few seconds, and as quickly dissolved again in sparkling coruscations of electrical explosions; at such times it has the appearance of sparkling diamonds darting over a snowy white surface.

From this description it is easy to conceive how these clouds may be compounded in their nomenclature, while the different kinds of cloud thus designated may not at all touch each other, but be only one behind the other. In looking down upon a cloud field, with the earth visible between its openings, it has the appearance of touching the tree-tops. So in letting anything drop overboard, when it has descended but half-way to the earth, you look for its contact below, while it continues spiring and falling until you tire of watching or lose sight of it before it lands.

The form of clouds depends upon the peculiar action that calls them into being. While some are the result of aërial nodes, others are formed by the spiral upward motion of the air in their centre, and this seems to be only the result of a previous downward pressure of air around the outside.

While the sea plays the part of the blood of the world, the atmosphere plays the part of its breath, and the intertropical belt comprises the heart and the lungs through which these functions are actuated.

# CHAPTER XXXVI.

First ascension alone of Charles E. Wise—His account of the trip from Shannondale Springs, Virginia.

MY son, Charles E. Wise, having made several trips with me, was exceedingly desirous of an opportunity to manage a balloon without assistance. On the 3d of September, 1853, having made arrangements for Shannondale Springs, Virginia, I determined to give the boy—he was then about seventeen years of age—a chance to distinguish himself. The following is the narrative of his voyage, which he wrote on his return:

"Quarter past two o'clock. 'Charley, jump in the basket.' 'Yes, sir; what for?' 'To go up in the balloon.' 'Jump out.' 'Get in again.' This was the conversation that passed between my father and myself. I then requested him to give me my knife and money to pay my passage with the balloon back to Shannondale, and at twenty minutes past two o'clock, on the 1st day of September, 1853, I was cast loose from terra firma to make my first aërial voyage alone. The last words I heard my father say were that I should ascend until I passed through the clouds and then come down again. At two and a half o'clock I was about midway between Charlestown and Shannondale; at this time I heard what appeared to me to be a child's voice saying, There goes the balloon. I then cried, Huzza, huzza, huzza! and waved my flag, and in a moment or two I heard a faint noise coming from, as I supposed, the large assembly of persons of Shannondale. A few moments after this I threw out a box of matches wrapped up in white paper, and I watched it until it fell in a clover field. I found now that I was rising rapidly above the clouds; I then tried the valve to see whether it would work. This I did by drawing the valve-cord and letting it go again, to see whether it would snap and make a noise, which it did not do. While I was doing this, I thought I heard the cars coming up the railroad, and while I was looking for them I let the valve-cord go; I then found that the noise ceased; I opened the valve again, and heard the same noise; I therefore concluded the noise was occasioned by the gas escaping through the valve when opened. I now looked for Shannondale, and one of the most magnificent views met

my eyes that I ever beheld. There was the Shenandoah winding its serpentine course down to the Potomac at Harper's Ferry, with numerous small islands at its mouth, also the bridges at Harper's Ferry and Point of Rocks, and the Potomac winding its crooked course up and down until it seemed to enter the clouds each way as a mere thread of silver. I again thought of Shannondale, which I found by looking for the horse-shoe bend in the river which I had noticed before. I soon found it, and had a fair view of Shannondale and its vicinity, also the Blue Ridge and the country beyond, until the earth seemed to merge into the clouds. I now looked for Charlestown, and found that I was nearly over it. I was at this time very high above the clouds, and moving very slowly. I stood over Charlestown for half an hour, and saw a pool of water and what appeared to me to be a circus ring close together. The balloon then slowly moved off toward Harper's Ferry, and kept in that direction until I got within about three miles of it. I then came down some distance at this point and struck another current of air, which took me toward Shepherdstown. Not knowing what place it was, I came down to within about three quarters of a mile of the earth, and asked how far it was to Winchester several times to some persons ploughing in the field, and they commenced huzzaing. I told them to listen, and asked them again how far it was to Winchester, but they said, 'You are on the wrong track.' I asked them what town that was, meaning Shepherdstown, and I understood them to say Dover. All this time I was close to the ground, and could hear the ducks, chickens, geese and peafowls cackling, the dogs barking and men huzzaing.

"I now commenced ascending again, and saw another large town to the left of Shepherdstown. I thought I would come down there; but as I was going above the clouds, I happened to look at a large cloud beneath me, but broken in several places, and on this I discovered a rainbow in the shape of a quarter circle. Casting my eye a little more to the right, I saw that the rainbow was continued, and looking still more to the right, I found it formed a perfect circle about as large as a circus ring. I was now ascending very rapidly, and the rainbow was gradually diminishing, until it vanished altogether. I was at this time at my highest elevation, which I supposed to be over two miles; at this time I crossed Kearneysville dépôt, when I gave a loud huzza and waved my flag; I soon heard them answering me quite lively. I was next within about half a mile of Shepherdstown, which looked to be quite a large place, and I had a mind to come down there. I thought I would look for the larger place I had seen once before; but the clouds having got very thick in that direction, I could not see it again. The mountains now appeared to be coming very close together; I thought I had better be looking out for a good place to land. I was now still extremely high, and the clouds appeared to be lying on the earth below. Here I looked around my car for a long rope that I knew must be there, which I found after a hunt of a few moments; and having fast-

ened it to the edge of my car, I threw it overboard. I then commenced descending slowly, seeking the best place of landing. Seeing a fine grass-field about one-fourth of a mile ahead of me, I thought I would come down in it, and commenced descending rapidly. Seeing a man on horseback, I called to him to catch my rope. He looked all around, but never upward; he then rode off down the road pretty fast. A flaw of wind striking the balloon when it was within 300 feet of the earth, blew it into the woods about 100 yards, but letting out a little more gas as I got over a clear spot in the woods brought me down in it, and the network over the balloon caught in a tree about forty feet above the ground. In a few moments three ladies came to my assistance and took hold of the rope and got it off the tree, without injury to the balloon or myself. By this time some twenty persons had assembled, who kindly volunteered to give me every assistance in their power; and so with their help I soon had the balloon and network packed in the basket, thus concluding my first aërial voyage alone at ten minutes past four o'clock, having been in the air about one hour and fifty minutes. There was a quantity of tissue-paper in the basket, as also my flag-staff, which were soon divided among those present as tokens of remembrance. About this time I remembered that I had a bottle of wine which had been placed in my basket by my friends at Shannondale, for the purpose of treating my friends where I might land. So we all adjourned to the nearest spring, and joined in finishing the bottle. As one of the persons present was about taking a drink, he was reminded that he was a Son of Temperance; his reply was that the Order of Sons of Temperance did not prohibit the drinking of spirits that came from above. I landed on the farm of Mr. Ehud Turner, situated about one half mile from the Potomac River and the same from the Opequan Creek. From Mr. Turner I learned that I was five miles from Williamsport, ten miles from Hagerstown, five miles from Shepherdstown, and twenty-four miles from Shannondale Springs. Mr. Turner treated me with every kindness, giving me my supper, lodging and breakfast, and in the morning sent me to Shepherdstown, for all of which I feel deeply indebted, as he would not receive one cent for all his trouble. From Shepherdstown to Charlestown I was brought by Mr. Brooks, and at Charlestown Mr. Sappington had a horse and buggy in readiness to convey me to the springs."

# CHAPTER XXXVII.

Miss Bradley's ascension from Easton, Pa.—Explosion of the balloon—Heroic conduct of the lady aëronaut—Narrative of an ascension made by Mrs. Louisa Wise.

IN the fall of 1854 I sold an old balloon, considerably worn, to Miss Lucretia Bradley, for one hundred dollars, and cautioned her at the same time concerning its condition and the necessity of handling it carefully. To all of which she replied, "If it was strong enough for you, it is strong enough for me." In January of 1855 she made an ascension with it from the town of Easton, Pa. It may be mentioned here that a balloon to be used in mid-winter should be in a very elastic condition. This balloon, being very dry, and consequently brittle, should have been well oiled before being used, to prevent it from breaking. It was not, however, the brittleness of the balloon that caused its explosion. The disaster resulted particularly from the manner in which it was rigged, and the irregularity of the network over its surface. Another immediate cause was the smallness of the neck-pipe, which acts as a safety-valve for the escape of gas when the balloon became fully expanded. The balloon, if made of the strongest material that can be procured, will surely burst if no complete provision is made for the overflow of gas when it becomes filled in the higher and rarer atmosphere. These points Miss Bradley informed me she would never thereafter forget.

Miss Bradley was a woman of more than ordinary qualifications, active and elastic as a deer, and possessed of a spirit of determination that knew no discouragement in anything she undertook. The "Eastonian" said of her most truthfully that she was "a brave, enthusiastic and accomplished Yankee girl, and don't want to be anything else." Her experience with the balloon referred to is best told in her own words:

"I rose in perfect calmness and with great velocity to a height of over two miles, my feelings being those of indescribable tranquillity and great delight. There was no perceptible breeze until I reached the highest point of my voyage, directly over a bend of the Delaware River, when four heavy currents struck my balloon on all sides with

equal force. Finding the balloon full, I opened the valve three times in succession; and while letting off gas as fast as I could, the balloon at the same time rapidly emptying itself from the mouth, a very strong undercurrent forcing up into the mouth of the balloon, caused a roaring like the ocean in a heavy storm, followed by a noise like the discharge of a cannon and a sudden fall of a hundred feet. I then looked up, and saw the balloon all shattered, with the exception of two parts, one being about an eighth of the whole balloon. This formed a parachute in the upper part of the network, and the other part formed a sail on the side, and thus I was borne off eastward. The wind rocked the car violently at the time, and for ten minutes thereafter. Although knowing my situation, this produced no feelings of fright or anxiety whatever; but tranquilly trusting in that same almighty Power I ever loved to trust, I prepared myself in the best possible manner I could for my descent, believing I should land safely. I threw out my sand and grappling-iron, placed myself firmly in the car in an upright position, my hands extended clasping the rim on each side. I spent the ten minutes of my descent in singing a song of praise to the Creator for the sublime scene of beauty and grandeur that surrounded me in this my first aërial adventure. Rapidly descending, I landed safely but with great force in the middle of a large clover field in Still Valley, New Jersey, four miles from Easton, at half-past eleven o'clock A.M., having been up just half an hour."

Upon an analysis of Miss Bradley's description, it will be observed that the balloon burst from over-pressure, caused by the rapid ascent she was making. The fact that the balloon was discharging gas from the neck at the same time that the valve was opened makes this evident. What she conceived to be the four currents of air that struck her balloon with force was the natural result of the balloon's explosion. The noise she speaks of is the inevitable accompaniment of such accidents. Taking the whole story as related by her, it was a remarkable affair. It shows a fortitude and presence of mind not common to the human family, and seldom to be found among the characteristics of the female sex. Woman, when really determined, seems to be more daring than man. It would naturally be supposed that Miss Bradley had enough of ballooning after this her first adventure, but it did not prove so. She immediately made application to the writer for a new balloon made of Irish linen. She also had constructed a water-decomposing machine, with which to generate hydrogen by passing steam over incandescent iron. Finding, however, that the public did not fairly appreciate her energy and progressive spirit, she soon after retired from the field of aëronautics with the reputation of being one of the most heroic women of America.

Ascensions by ladies have frequently been made in Europe, but they have not been common in this country. Some of the ladies of my family have, however, occasionally taken a trip to cloud-land. The reader will perhaps be interested in the following account of a trip

EXPLOSION OF MISS BRADLEY'S BALLOON.

from Lancaster, written by Mrs. Louisa Wise, the wife of my son. The ascension was made on September 18, 1869, at 4 o'clock P. M. The narrative as communicated to one of the Lancaster papers is as follows:

"I am not an advocate of woman's rights in the modern acceptation of the term, but have nevertheless a notion that a lady might take a ride through the ethereal regions of space without sinning against the proprieties of her sex, or in the least infringing upon the good order of a 'time for all things;' and believing that the proper time had come to gratify my woman's curiosity upon this subject of an aërial voyage, when my husband announced that he would sell the vacant seat in his balloon chariot 'Jupiter,' I accordingly resolved to be the highest bidder, though it should be a thousand dollars; when he very gravely suggested to me about the pay, having, as he said, two cash offers of fifty dollars each, I told him mine was a hundred dollars, paid in advance, by numerous charges against him for darning stockings and sewing on his buttons for ten years past. From this he made no appeal, but said, 'All right; you shall go.' And now, Messrs. Editors, through the medium of your paper, I will tell my lady friends, as well as I can, how I did go.

"At ten minutes past four o'clock last Saturday afternoon, 'Jupiter' being sufficiently inflated, I stepped into the wicker-car thereto attached, and with a throb of delight loomed up and over the centre of the city. The multitude below, with upturned faces, the rattling sound of martial music, the shouts of applause, and the earth with all this life, gradually sinking down, down, still deeper down, excited me very much, and I involuntarily began to wave my 'kerchief in response to the happy salutations of my good friends below. My husband handed me the talismanic flag to wave, while he would throw overboard ballast composed of bundles of business circulars, and up, up we went at a glorious rate. My replies to his questions for a while were only 'Splendid! splendid!' My heart was palpitating with joy over the beauties spread out beneath and around, so that I could do nothing but gaze upon the grand scene before me. When we got beyond the built-up part of the city, I ventured my head through the barrier of ropes to look straight down, and beneath I spied what seemed a nice little Christmas garden, with little buildings in the middle, which my husband told me was Franklin and Marshall College, and just at this moment a milk-like vapor rushed down before and underneath us, entirely obscuring the world below. All at once my joy and observation changed to a feeling of amazement—amazement most profound. Oh what a solemn silence surrounded us! It was an awfully mysterious thing to me how this heavenly curtain of dew-drops could so suddenly wrap itself all around us. The big, puffed-up globe above our heads, scarcely visible, seemed to bend and stagger with this load of vapor weighing upon it. Presently a cheerful, mellow glimmer of light came from above, which cheered us again into conversation. Here Mr. W. threw overboard a considerable bundle of business cards; and as they

scattered through this illuminated cloud, they crackled like little torpedoes. I wondered what caused it. Mr. W. said: 'It sounds like electric sparks.' As they floated leisurely about, they shone like silver and gold. Presently we came out at the top of this cloud, and here again came a new scene. How strangely beautiful up here! immense masses of white, soft-looking, fleecy clouds below. Oh, they looked as soft and silky as the finest down, and they rolled about, as it were, in a wanton voluptuousness. 'But where are we now?' I inquired; 'I can't see the world; we are entirely partitioned off; how will we get down?' Mr. W. said: 'I will take you down now; but before we go, let us eat a bite of our provisions, kindly furnished us by our friend John Sides.' 'No, indeed,' said I; 'this is a feast of reason; I can only feast with my eyes.' But to please him I ate a few grapes off a bunch placed in the car by John Adams, which he was devouring with a gusto that indicated a keen appetite, and he also got out of the basket a roasted fowl to regale himself with.

"While in this solemn stillness I was suddenly startled: 'Oh, what was that?' Mr. W. said: 'I let off some gas to go down.' When the valve snapped shut, it cracked like a gun and made me tremble for a moment, it made such a strange noise up there. Now we gently and softly sunk down through this fleecy bed below; in its midst it was more dark this time, and as we came out gradually below, I saw the city as behind a thin gossamer curtain, and the clattering of iron wheels, and puffing of steam engines, and ringing of bells, contrasting strangely with the bright silent world above the clouds.

"Here we could see the beautiful Susquehanna, and here and there a village peering from behind a dark cloud, and the people below hallooing all around us, and I heard a voice distinctly cry, 'Charley, come down, come down, come down!'

"We repeated these cloud scenes five or six times, going up and down, and I was almost led to believe that when we shall change from mortality to immortality it will be our happy destiny to soar through the realms of space, visiting on spiritual wing this globe and that globe; for the good book tells us that 'in my Father's house there are many mansions,' and I verily felt, when I was up above the clouds, that I was in the house of God, it was so solemnly grand and sublime.

"I shall dream of this all my lifetime. I can now hardly realize it; it seems to me more like the shadow of a vision, a trance, than a positive thing. I don't think anybody could make such an adventure without becoming better, and particularly grateful to the Creator for the privileges he has granted us.

"We landed safely one hour and ten minutes after we left the earth on the farm of Mr. Hoffman Hersey, about nine miles north-west of the city. Mr. John Herr invited us to his house, where we took supper.

"LOUISA WISE."

## CHAPTER XXXVIII.

Ascents from Boston Common—A balloon chase over Boston Harbor—An anticipated collision between a balloon and a yacht.

DURING the years 1855, '56, '57 and '58, I made a series of ascensions from the city of Boston and through the New England States. Some of these are worthy of note. Cloud-land scenery, although as much diversified as earth-land scenery, has nevertheless a general characteristic. It is only some extraordinary meteorological phenomenon or some abnormal disturbance that will be noticed in this relation. For four successive Fourths of July I had the honor of being the guest of the corporation of the city of Boston, having been engaged to make aëronautic displays from Boston Common incident to the festivities of that natal celebration. There is no place in America where the "Cradle of Liberty" is rocked with the same ardor and patriotism as among the people who inhabit the fields of Bunker Hill. Fifty thousand spectators around the balloon is a low estimate; eighty thousand, it was said, did not exaggerate the number that upon one occasion filled the natural amphitheatre rising from the grass-clad basin of the Common, from which the balloon ascended. And there the decorum and system of the arrangements were peculiarly Bostonian—everything to time. Under the order of the chief of police, the performances went off like clock-work. Several times we had two balloons, the "Old America" and the "Young America," and at another time "Jupiter" and "Ganymede." In these ascensions my son Charles E. Wise acted with the junior balloons.

On one of these occasions the upper air was traversed from west to east at the rate of a mile per minute, as indicated by the passage of the cumulus clouds. Although we had learned before this that we could sail out over the harbor in the upper air, and return to land again with the sea-breeze below, which is always a condition of the air on warm summer days, it was nevertheless advisable that "little boats should keep near shore." The junior balloon being timed to start thirty minutes before the senior, and the appointed minute having arrived, she was let go. I had admonished my son about the rapidity of the upper outward current, and said that it would take him far out over the sea unless he touched it but slightly with his balloon. His

balloon going up rather slowly at first, he threw off considerable ballast, and then made a rapid ascent, which was followed by a rapid transit out to sea. The committee of arrangements for the celebration being present, and becoming apprehensive over the young man's movement out over the water at so rapid a speed and at so great a height, immediately gave me permission to anticipate my time of starting, in order "to look after the boy." In a few moments I was up and off. To me it seemed more like a hide-and-seek play than anything fraught with real danger, as I was aware that the experience of the lad was sufficient to guide him in his movements. He would only have to let off gas, come down low, and round inward with the lower current. Should his valve fail to work, he knew he had only to discharge ballast copiously, shoot up until the gas was out of the lower safety-valve by overflow, and down he would come. Having plenty of gas and ballast on hand, he was in no immediate danger.

I soon reached the eastward current, and in pursuit of the junior air-craft felt my entrance into it gradually. This gave me an opportunity to scan the eastern horizon leisurely. After a view and review of about ten minutes, I could discover no fugitive balloon. I saw the harbor filled with pleasure craft, and ships way out at sea, and some looming up from the eastern horizon, as my air-ship raised itself higher and higher. It is always a glorious sight when you see the magic circle of horizon lifting itself up like a vast curtain and uncovering the objects in the distance which are concealed behind the convexity of the globe. Remember, this curve is eight inches to the mile, and increases with the squares of the distance. I looked and looked, but looked in vain. What had become of the junior balloon? It certainly could not yet have disappeared in the distance, as I could see out a hundred miles or more. Ships were still coming up from the unfolding horizon, but balloon there came none. How is this? Had he sailed beyond the horizontal wall of air and water? It could not be. Fifteen minutes of a start could not have taken him over fifteen miles ahead of me, as I was now passing in exactly the same direction. The "Graves" were in front and below me. Perhaps they were the tombstones for aëronautic graves! I looked round and about this outer cemetery. Now I began to scan the horizon and trained the eye inward over the surface. Soon I perceived the air-bubble floating, as it seemed, upon the surface of the sea. There she is, water-logged, and a yacht in hasty pursuit of the "flying Dutchman." It was a beautiful sight, romantic as it was beautiful—air-craft and water-craft in fraternal conjunction!—the two great elements of our planet giving positive testimony of their obedience to the domination of man. I exclaimed, "Oh for a life on the ocean wave and a flight in the balmy breeze!"

Dropping down gradually, as I had now discovered the truant balloon, I watched with eager interest the coming contact of the water-craft with the air-craft, supposing them to be on the same level. When

A BALLOON VIEW OF BOSTON.

you are 8000 high and another object 5000 below, and consequently 3000 feet above the surface of the earth, the object below seems to rest upon the earth's body. Gracefully the wind-expanded yacht was moving its boom for the air-bubble. Now it was only a few yards off. "Presently," I thought, "I shall see the gas fly. If they have fire on that yacht, look out for a gas explosion." Such were the momentary thoughts passing in my mind. "There she goes!" For a moment the tiny boat was hidden. It was like the occultation of Venus behind the moon. No explosion followed. The yacht went through the balloon, or it went under. "How is it? Certainly that balloon is drifting on the water. It is now moving for Nahant rocks. By the angle it now presents I can see the car trailing in the sea, leaving a streak in its wake. Now it is dragging over Nahant rocks. I see it bumping over the rugged cliffs. There! it has swung itself over into Lynn Bay. It seems to be rising as it is getting farther off. Now it seems to be passing over Egg Light." Here I had sunk low enough to encounter the sea-breeze, and was soon wafting landward over Powder-house Hill, making the detour by a circle within that of the junior balloon, since I had not reached so great an altitude on the lead.

On the evening of that day the committee of arrangements met at a little collation improvised on account of their inability to partake of the celebration banquet of the day. To this we were invited, in case we should land at a place that afforded facilities for reaching the city in time to be there. The junior, sailing his craft into the city of Lynn, was taken in charge by the ever-vigilant police of that place, they seizing his tow-line and escorting him to the Common, where his balloon was disflated, and he and it soon sent on their way to Boston on an ingoing train.

The senior coach, being more conservative, passed inland some three miles before it landed, and found itself in the trimontane city half an hour later. On my arrival at the festive board, a hint to relate *my* adventure was responded to in the form and manner as above. It drew a smile from the guests, as the narrative differed from the facts as related half an hour previous by him who constituted the main part in the story. He had not been within one thousand feet of the yacht, nor at any time during his flight over the harbor was he near the surface. Having been carried out some ten or twelve miles by the upper current, he dropped down gradually and rounded in with the sea-breeze. When I saw the balloon and yacht in close proximity, I was almost directly above them, and from that the reader can imagine how the two things looked as though they were in contact. When the aëronaut is high up above the clouds, these fleecy tenements of the air appear to be scraping the chimney-tops below.

After the banquet-table was abandoned, the party strolled to the Common to witness the grand display of fireworks. We all took seats to see the discharge of pyrotechnic shells projected high into the air,

where they dispersed showers of various colored stars and fiery serpents. In one of these discharges a crashing explosion indicated that an accident had occurred. The mortar used for the purpose burst into fragments; a piece went whizzing over our heads like a bomb, another struck an attendant of the ordnance, and in an instant a living soul was sent to the realms of eternity. The aëronautic display terminated safely, pleasantly, satisfactorily. The pyrotechnic display ended with a human victim. While we were suspended, as it were, by cobwebs high in the air, thousands of hearts were palpitating for our safety. While the same thousands were congregated on the solid earth, not dreaming of any peril in their surroundings, Death came and did his work.

All the ascensions we made from Boston Common were full of interest, and it was during these that my son Charles proved himself sufficiently accomplished for the profession, though I advised him to abandon it as such, because it had been brought into low repute on account of having fallen into the hands of acrobats and mountebanks—not that I would for a moment deny that class of men the right to practice the art as they do, but that men are usually judged from the company they keep. In writing this I am far from throwing a slur upon men who are in the amphitheatre, because some of them are men of genius and respectability. These, however, I regret to say, form the exceptions to the rule.

As a curiosity, I give for an illustration of this chapter a view of a portion of the city of Boston as photographed from a balloon. So far as I am aware, the photograph from which this cut was made was the only view of a city ever taken, and it is of particular interest, as it shows the part of Boston destroyed by the great fire of 1872.

## CHAPTER XXXIX.

Ascension from Bradford, Vermont—The White Mountains as seen from a balloon —Ascent from Bangor, Maine—Perilous descent in a forest.

I HAVE made a number of ascensions from the White Mountain region of Vermont, and am compelled to confess that my pen is inadequate to a description of the sublimity of the landscape that greets the eye of the air sailor. An account of a voyage which I made from Bradford, Vermont, on September 28, 1857, in the balloon "Young America," will, however, give the reader some idea of the glories of nature that were revealed to my sight.

The ascension was made from the Agricultural Fair ground at five minutes before three P. M., and in a few minutes an elevation of three thousand feet was attained, when a dog and a parachute were let off. The experiment went off very handsomely, and Tray seemed rather to enjoy his downward journey, and by the time he had reached terra firma, the "Young America" attained an altitude that overlooked one of the most magnificent panoramas that human eye could contemplate. Mountains upon mountains, as far as the eye could reach, all around, and just above the visible horizon a beautiful curtain of clouds encompassed the vast panorama. The road up Mount Washington was distinctly visible, though it was many miles off.

Having now attained an altitude of over two miles, and being about twenty miles east of Bradford, the earth below presented to view a vast basin interspersed with hillocks and lakes—of lakes not less than fifty were in sight, and of mountains the number was legion—and here several large buzzing flies came hovering round the car for some minutes. This somewhat surprised me, considering the great height above the earth; and I also felt somewhat surprised at finding the atmosphere pleasantly warm, and where the sun shone on my body it produced a sensation like the pricking of needles. At half-past three the gas commenced rushing from the neck of the balloon, which was compensated by a proportionate discharge of ballast, as I wished the balloon to hold this altitude, seeing the current would waft me somewhere near to Portsmouth, N. H., and thus bring me on the Eastern Railroad, which would facilitate my journey to Bangor, at which place I was announced to ascend on the 30th of September; and, moreover, the current was moving at the rate of a mile per minute. As I was sailing along, I could

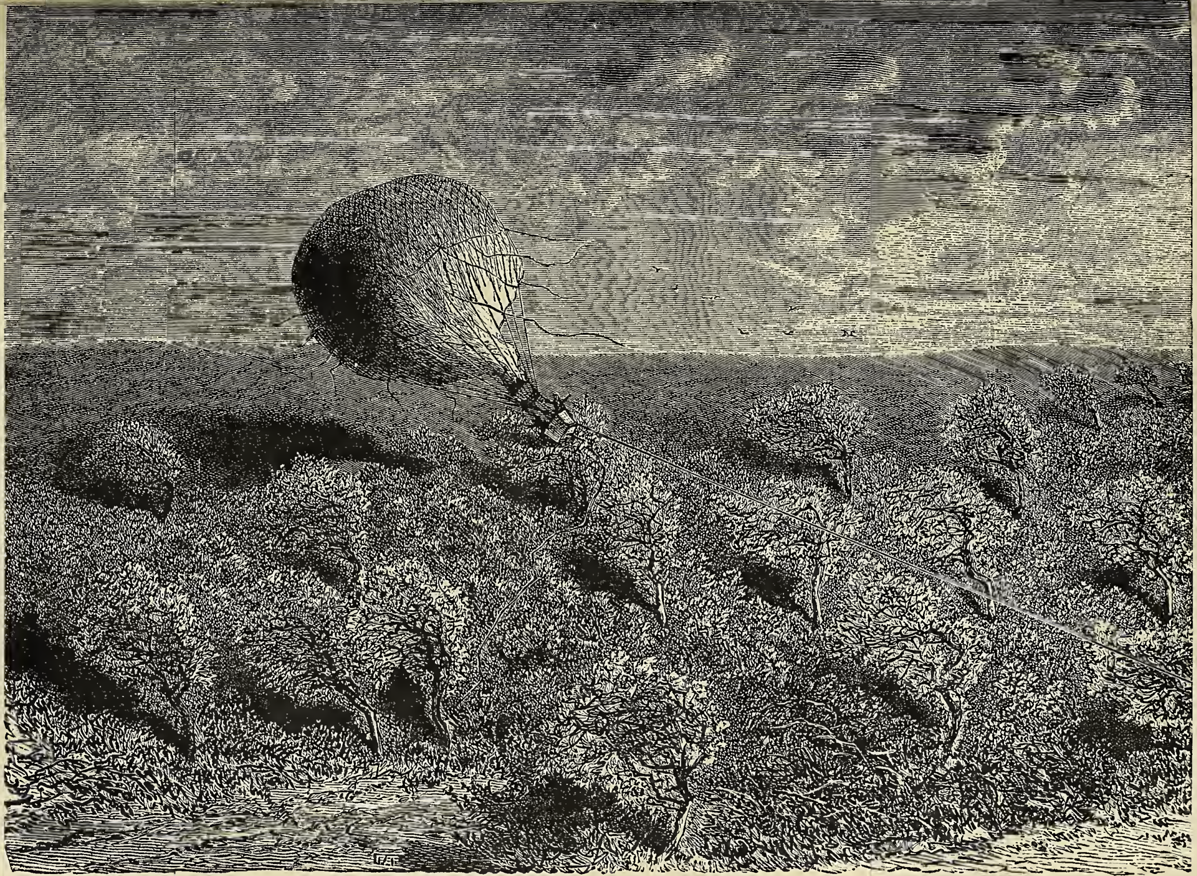
not refrain from exclamations over the beautiful forms God had given to the world, and it impressed upon my mind the conviction that a higher destiny awaits mankind than steamships and rail-cars can possibly supply—the perfection of the art of aërial travel.

At quarter of four I crossed a village and observed a railroad beneath, with Lake Winnipiseogee to the east. This is full of islands, and the little steamboats were navigating through it, and it puzzled me for some time to find the narrow passage where they got through from the lower to the upper portion of it. The whole length of the lake did not appear over three hundred yards. I rose considerably here, by which I reached the upper current of wind, and thus made a detour along the southern border of the lake. A very handsome bouquet of flowers was presented me by a lady when I started from Bradford, and upon getting up to my former altitude, it gave out for the second time a fragrance so sweet and strong that I became satisfied some peculiar atmospheric phenomenon was going on in the distillation of essential odors, as there was also at the same time a pungent stinging sensation produced on my hands and face, probably superinduced by the discharge of hydrogen from the safety-valve of the balloon.

The scenery beneath and around had now become so interesting that I laid down my note-book, determined that I would no longer, for even a moment, be deprived of seeing any portion of it, inasmuch as I was gliding over the country so rapidly. Villages innumerable encompassed me on all sides; in some of them the church bells were rung as I passed along, and all around the villages saluted the arrival of "Young America" by firing of guns and earnest invitations to alight. Over some localities I was enabled to keep up a running conversation, and over others I could not; but I noticed that where it could be done the echo of my own voice was always very distinct in its returning sounds.

At four o'clock and fifty minutes my note-book says: "Crossed a volcanic crater." It was so noted because the geological appearance of it looked like pictures drawn by eye-witnesses of extinct volcanoes. The exposed upheaved rocks around its top seemed as regularly broken up as would be the explosion of a mine with gunpowder. The mineralogical character of the rocks was not discernible from that height. There were many objects passed over for which I could find no explanation; several square enclosures with no habitations near them seemed strangely isolated in the mountain-encompassed valleys.

At five o'clock I came down low enough to converse with the villager and country people as I sailed along, and this I was enabled to do for several miles from either side of the balloon's track. All animated nature was aroused below. Girls and boys were hallooing, the old folks were talking at the top of their voices, the dogs were barking, the cattle were lowing, the poultry were clamoring, guns were firing, village bells were ringing, and locomotives were piping their echoes through the hills, and the whole formed such a wild and en-



DESCENT IN A MAINE FOREST.

chanting drama that I felt no disposition to withdraw my attention from the immediate surroundings below, until the long line of sea-coast from Portland to Boston admonished me that my voyage must soon be brought to a close, and besides, that the sun was now lowering himself behind the mountain horizon of the west. These two extremes presented a gorgeous spectacle. The sun seemed blazing down broad beams of fire upon the mountain-tops, and beyond the mountain-tops the atmosphere seemed red hot. To the east the long line of sea-coast had emerged from the distant horizon to a limited extent, and was finished off with a murky, cold-looking bank of clouds that prevented further vision.

Having now neared the Eastern Railroad, I came down into a local south-west breeze which wafted me along between Dover and Rochester, and I effected a good landing one mile from the town of Great Falls, in New Hampshire, close on the border of the State of Maine.

From this point I proceeded to Bangor, Maine, where I had promised to make an ascent on October 10th. At the appointed time the balloon was ready; and although the day was squally, I determined to make the ascent.

At precisely 12 M., the hour announced for starting, the "Young America" was released from her trammels, and darted upward like a winged steed, vibrating and gyrating tremendously for the first five minutes of ascension, owing to the great ascending power with which she started, and which was necessary in order to clear obstructions around the point of departure.

After the clouds were surmounted, a long line of sea-coast glittered among the heavenly objects, opening up the most enchanting scenery in that direction. To see the fleecy clouds and the ocean intermingled, as it appears to the aëronaut when sailing above the level of the clouds, is a sight that cannot well be described. It must be seen to be appreciated.

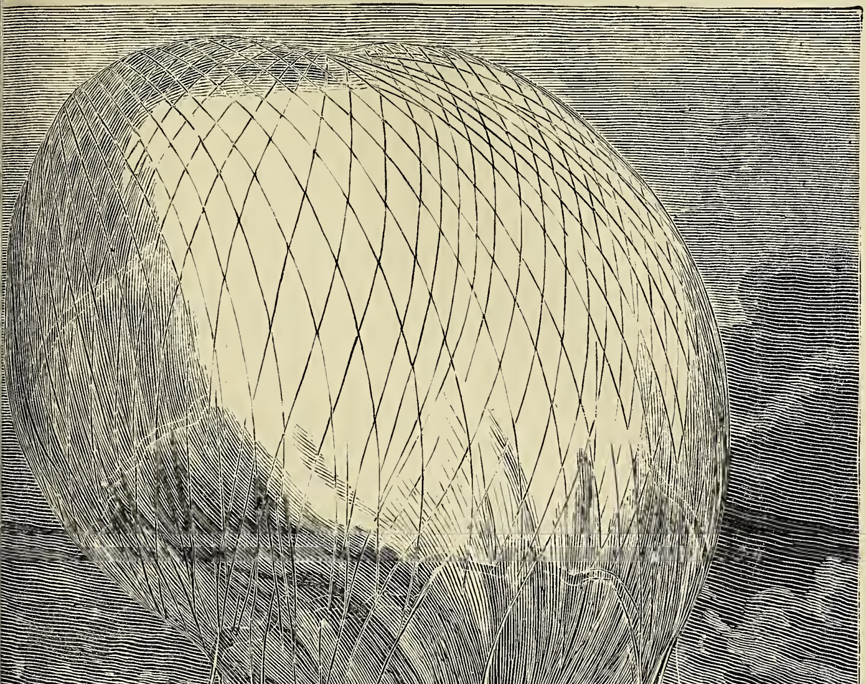
Upon taking a general observation, thirty minutes after starting, I found the current wafting the air-ship rapidly eastward, and thus out of the direction of Great Works, the place I had calculated to land at. By the time I had lowered into the current with which I started, the line of direction was into an uncleared and uninhabited country, and I made preparations to alight as near the bounds of civilization as possible. I could not intercept a single clearing, and the balloon was making rapid strides over the wilderness. My next best calculation was to alight in some thinly-wooded juniper bog, which was accomplished about five miles north-east of Great Works River.

The grapnel took hold, and everything promised a tolerably fair landing. Already the gas was fast exhausting, and upon looking at the time of day, I found the voyage was of one hour and five minutes' duration, when all of a sudden a squall came howling through the trees, and snap went the side of the car. The force of the wind ripped the grapnel rope through the side of the car, and the willow work flew in all directions. Such was the force of the wind that the balloon

hurled the broken car over the tree tops and occasionally jammed it against the body of trees, so as to cause most terrific concussions, with considerable wear and tear upon my apparel, and an occasional admonition that it were best to spring from the car to save broken bones. I stuck to the ship, however, until it had dragged me over a mile across tree tops and swamps full of underbrush, and finally through a pond or lake, dousing me several times under water.

This part of the voyage was as terrific as the earlier part was sublime, and I felt loth to part with my ship, and did not until it had dragged me across the pond, and was about dashing me headlong into a scraggy piece of dry woodland, where I concluded that it was best to jump.

At five minutes after one P. M. the "Young America" left me in the midst of a wilderness, out of which I made my way with compass and chart. After travelling two hours I made the stream of Great Works. This I followed down four or five miles, which brought me near Oldtown, where I arrived at six o'clock in the evening, whence I took the cars and arrived in Bangor at eight o'clock.



THURSTON CARRIED OFF.

# CHAPTER XL.

Balloon accidents—Thurston's fearful adventure with a runaway balloon—The cause of the disaster—A similar experience of the author.

ON the 16th of September, 1858, Mr. Ira Thurston and Mr. Banister made an ascension from Adrian, Michigan, which had a fearful ending. Every case of loss of life in the conduct of aëronautic experiments in my experience has been the result either of carelessness or lack of knowledge, and a narrative of Mr. Thurston's adventure is worthy of a place in such a work as this, if only as a warning to the reckless. The following description of the affair appeared in the Detroit *Tribune:*

"The first ascension took place about nine o'clock in the morning. It was on the occasion of a large Sunday-school celebration at Adrian. The balloon was a very large and well-constructed one, being about the height of a two-story building when inflated and ready to cut loose from its fastenings. Messrs. Bannister and Thurston took seats in the car attached to the balloon, and ascended safely and steadily. After remaining about forty minutes in the air, sailing toward Toledo all the time, they alighted in the woods in the town of Riga, Lenawee county, near Knight's Station, on the Southern Railroad, distant about eighteen miles west of Toledo. Several men came to the assistance of the adventurers, and they proceeded to prepare the balloon for packing, to be taken back to Adrian.

"In doing this the monster balloon was turned over and partially upside down, to disentangle the netting and to reach the valve. To do this, Mr. Ira Thurston, one of the aëronauts, took off his coat and got astride of the valve-block. He then suggested that the car be detached from the balloon while he should hold it down with his weight. This proved a fearful calculation, for no sooner was the still inflated body relieved of the weight of the car than it shot into the air with the suddenness of a rocket, taking Mr. Thurston along with it, seated upon the valve of the balloon, and holding on to the collapsed silk of the air-ship in that portion of its bulk. In this perfectly helpless condition the ill-fated man sped straight into the sky in full sight of his companion, more helpless than himself. So far as is known, there was no possible means for him to secure his descent,

whether safe or otherwise. The part of the balloon filled with gas was fully twelve feet above him, so that there was no chance for him to cut its sides and allow the gas to escape. He could only cling to his precarious position, and go whithersoever the currents should take him.

"Without regulation or control of any kind, the balloon continued to mount upward, sailing off in the direction of Detroit and Lake Erie. The fatal ascension took place about eleven o'clock, and at a few minutes past noon the balloon was seen in the town of Blissford, Lenawee county, apparently full three miles high, and about the size of a star in appearance. It was still going up and on. At a quarter past one o'clock it was dimly visible, going in the direction of Malden, as ascertained by compass bearings taken by parties observing it. What is his exact fate baffles conjecture, but that it is horrible almost beyond precedent there can be no doubt. There is not one chance in a million for a successful escape."

Some days after, the balloon was found in the vicinity of the St. Clair River, but the body of the unfortunate aëronaut was not discovered until the 6th of October. He fell near Sylvania, almost ten miles from the place from which he was carried away. From the appearance of the balloon, it is certain that when at an immense height the disk of the valve was torn off by Mr. Thurston's weight, and that, having nothing but the smooth surface of the balloon to cling to, he was precipitated to the ground.

Mr. Thurston lost his life in this way, in my opinion: After he and Mr. Bannister landed, he was in a hurry to disinflate the balloon, but forgot for the moment that the vessel had carried double his weight when he ordered the inversion of the balloon. I have often turned my balloon upside down when it had gas enough in it to carry less than my weight. It is done in this way: While some persons are ordered to let the neck-end of the balloon up slowly by the net-cords after the basket has been detached, the aëronaut pulls down the valve-end until he can reach the valve-plate. Having the valve-plate in hand, a disk of about fifteen inches diameter, it is common to clasp the balloon between one's legs, the valve acting as a button, preventing the balloon from slipping away, as the aëronaut holds on to the flaccid part of the balloon when the persons have let the net-cords go altogether, at which time the balloon will turn neck up very suddenly and with considerable momentum—so much so that a balloon once tore loose from the valve-disk for me, and on another occasion the momentum was so great and sudden that the balloon hauled me over an oak tree close by, caused by a flaw of wind which sprung up at the time. The net had fallen down over me, and was the means which enabled me to save the balloon from getting away from me after it had slid down over the tree; and I might with equal propriety say that the net falling over me prevented me from getting away from the balloon had I felt inclined to do so. It was a question whether the balloon had me or whether I had the balloon for at least the breadth of a ten-acre field, where I

brought up against a fence, and finally gained the ascendency and secured my air steed.

Thurston, no doubt, was caught in this way astride the balloon: with the valve-disk for his seat, it shot up with the net fallen over him, adding to his weight. In a few minutes he probably discovered that the valve was tearing out of the balloon, and then he would take his firmest gripe on the flaccid part of the balloon, where he might sustain himself twenty or thirty minutes at longest, by which time he would have been up from two to three miles, when he would drop off. The net, if over him, would fly away from him in the descent, unless he had a very firm grasp of it. After he had fallen away from the balloon it would turn up, and thus would remain nearly half full, only to lose ascensive power as the gas escaped from imperfections in the envelope.

A singular accident which happened to myself was thus narrated by one of the Lancaster, Pennsylvania, papers:

"The mammoth balloon named 'The Mammoth Hercules,' with which Mr. John Wise took up a pleasure-party from Philadelphia two years ago, is undergoing repairs in an open lot at the east end of this city. On Wednesday afternoon last, about 2 o'clock, while it was partly inflated with atmospheric air, and the workmen were engaged in giving it a fresh coat of varnish, it became necessary to turn the leviathan for the purpose of coating the other side. The balloon had been kept to her place by heavy sand-bags, and during that time the air in it became extremely rarefied. In order to turn it over, it required a person to go inside for an instant to see that all was right there, and for this purpose Mr. Wise entered it himself. As he entered, the weights outside were taken from it too quickly, allowing a sudden expansion of air inside, and in an instant the balloon was up and off, Mr. Wise enfolded in it and struggling like an eel in a net. The workmen were so confounded as to be perfectly at a loss what to do. The balloon, gradually rising, went across the field until it turned with its mouth downward, and spilled Mr. Wise out at the bottom, giving him a severer fall and more bruises than he ever received at any regular ascension. The balloon lodged on Mr. Swartz's barn uninjured. Mr. W. informs us that while he was thus moving onward and upward he endeavored to extricate himself by tearing the balloon open, which its great strength resisted, and that he was just in the act of cutting himself out with his pocket-knife as the balloon righted and spilled him out of its mouth."

During the present summer (1873) a frightful disaster occurred, which shocked the public and served to bring aëronautics into discredit. As the aëronaut, however, lost his life through his own ignorance or carelessness, or more probably both, it is not just that the science should be held responsible. On the 4th of July a Mr. Edward Lamountane undertook to make an ascension from Ionia, Michigan, with a Montgolfier fire balloon made of paper. His ascension and his fall to the ground were described as follows in the newspapers by an eyewitness:

"At half-past three in the afternoon he stepped into the car, leaning over to shake hands with some of the people who were near by. Again he examined all the apparatus within his reach, and five minutes later gave the word to let go the fastenings, and the balloon shot up bravely. Hardly, however, had the swelling paper globe ascended to the distance of a hundred feet from the position which it first held, when the spectators saw by its action and the agitation of the aëronaut that something serious was the matter. It did not rise symmetrically, but bunglingly, and there seemed to be some breakage in the substance of which the bag was composed. Yet still it rose, and people at some distance could see that the professor was greatly agitated, rushing about in his car, tugging at the ropes, which he was evidently attempting to arrange. It was a moment of the most intense anxiety, and the crowd stood breathless, while the balloon went higher and higher, until it attained an altitude of at least half a mile, when it paused for an instant; there was a struggle, and the body slipped from between the ropes that bound it to the car, which instantly began to fall, while the balloon, loosened from its burden, bounded up higher. The car upset and the professor fell, at first headforemost, and then turning with his legs and arms outstretched, wheeling like lightning toward the earth. Then his body assumed a position directly the reverse of its first, and he struck the ground feet first. His struggles in the air when the car began to fall were fearful to see. He tried to clamber into the basket, and then, seeing that this was futile, tried to use the car as a parachute by turning it upside down. But he finally let go, and, as has been said, struck the ground with his feet, and was frightfully mangled. Blood spurted from his mouth and ears, and in falling he made a hole in the earth five or six inches deep."

It is proper to state that this aëronaut was not John Lamountane, who made the great voyage from St. Louis to New York State with me in 1859, and it is doubtful whether his real name was Lamountane. Mr. John Lamountane died a natural death several years ago. The cause of Edward Lamountane's death was the neglect of proper precautions in securing the car to the balloon. No net was used, and the car was suspended from six ropes which were fastened to the top of the air-ship. Had care been taken to fasten them securely at equal distances at the equator, there would have been no danger; but with extraordinary recklessness, the aëronaut not only did not fasten them, but he made his ascension with four on one side and two on the other. As a matter of course, the balloon, so soon as it was fully inflated, bulged at the points where there was nothing to hold it, and finally slipped from between the ropes, the car with its occupant as a matter of course falling to the earth so soon as the ascensive power was withdrawn. The science of aëronautics cannot properly be held responsible for such an occurrence as this, any more than the science of seamanship can be for the loss of men who start out upon the ocean in a ship with two or three planks out of her bottom.

"IT SEEMED AS THOUGH ALL NATURE HAD GONE TO SLEEP."

## CHAPTER XLI.

The voyage from St. Louis, Missouri, to New York State—The start from St. Louis—Air sailing by night—A nap that promised to be a long one—Sunrise as seen from the balloon.

IT now becomes my duty to relate the particulars of an episode in my career as an aëronaut which I flatter myself will possess some interest for the reader merely as a narrative of adventure. In my opinion, however, this record of the longest air-voyage ever made is worthy of thoughtful consideration as a scientific experiment of the first importance to the human race. It was no hap-hazard scheme of reckless dare-devils, but a systematic attempt on the part of thoughtful men to demonstrate certain facts for the benefit of mankind, and it did demonstrate these in a most satisfactory manner. That the voyage was not an absolute success in every particular was due to the imperfections of the machinery rather than to scientific miscalculations.

Mr. O. A. Gager, having made a very interesting aërial voyage from Bennington, Vt., in company with Mr. John Lamountane, in a balloon which I had furnished to the latter, conceived the idea of having a large air-ship constructed for the purpose of making some experimental voyages from the distant interior of our continent, with a view to inaugurate a trans-Atlantic balloon line for the rapid transition of mails and passengers from the United States to the principal European cities. His calculations were based upon the many observations I had made upon the certain currents of the trade-winds.

In accordance with this conception, the balloon "Atlantic" was constructed agreeably to the directions laid down by the writer. Mr. John Lamountane superintended the work, doing much of it with his own hands. The balloon was a spheroid of fifty feet diameter transversely, and nearly sixty feet perpendicularly. It was rigged with a strong hempen network, and underneath it was suspended a wicker car, and beneath this again a boat of very light but very good workmanship, capable of carrying in the water a thousand pounds. This boat was cased in a heavy canvas jacket, by which it was attached with ropes pending from the concentrating hoop underneath the neck of the balloon. To this hoop was also fastened, by ropes of nine feet length, the wicker car. The ropes holding the boat passed down from

the hoop along the outside of the wicker car, and the boat hung fifteen feet below the car.

With this balloon and its paraphernalia I proposed to Mr. Gager to make an aërial voyage from St. Louis to New York, and upon this proposition the Trans-Atlantic Balloon Company was organized, consisting of five persons, each owning one-fifth of the whole concern. The company consisted of John Wise, John Lamountane, O. A. Gager, Mr. Johnson and Mr. Gilbert.

For navigating the balloon "Atlantic," the company was arranged in the following manner: Director-in-Chief, John Wise; Aëronaut, John Lamountane; Scientific Observer, O. A. Gager.

By the courtesy of the corporate authorities of the city of St. Louis, an enclosure was erected in the city common; and under an arrangement with the St. Louis Gaslight Company, the inflation was made from their supplies through an eight-inch connecting pipe with one of larger calibre in the street.

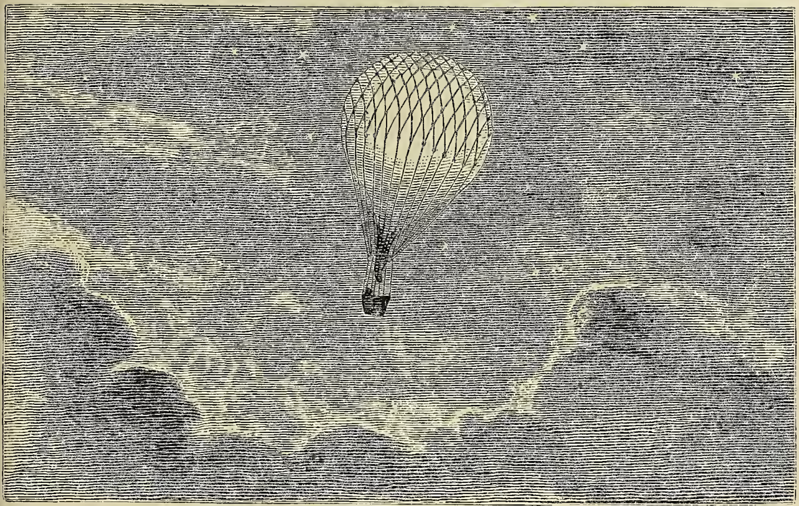
The ascension had been announced to come off on the first day of July, 1859, in the afternoon, and the voyage was to be made from St. Louis, Mo., to New York. The day was ushered in with excessive heat, but nevertheless the arena was filled with several thousand persons. The inflation was accomplished without any difficulty; and when nearly completed, Mr. Brooks, the aëronaut of St. Louis, proposed to fill his one-man balloon, and to act the part of pilot to designate the course of the "Atlantic," as a compliment to her voyagers. To this our company assented.

Another proposition came from Mr. Hyde, a reporter of the St. Louis *Republican*, desiring to accompany us in his professional capacity, and to this we cheerfully assented. The American Express Company also desired to take an interest in the voyage, and with this view requested us to carry to New York one of their overland mail-bags, filled with papers from the Pacific coast, and complimentary letters from citizens of St. Louis to their friends in the East, as a token of their appreciation of the novel mode of mail carriage thus to be inaugurated.

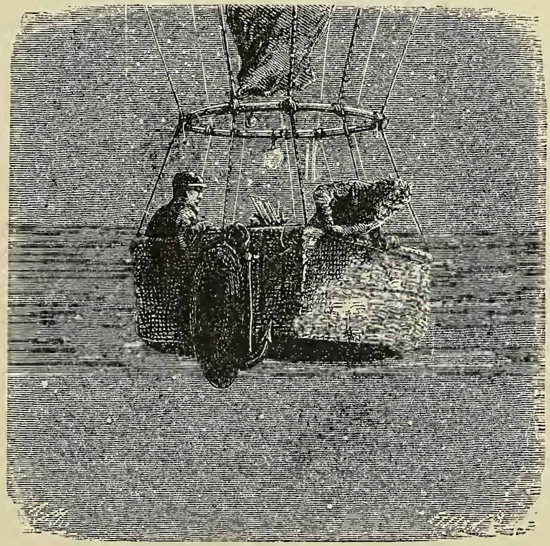
In the mean time, Mr. Brooks having inflated his balloon, it was cut loose from the earth, and sped its way upward and eastward.

The "Atlantic" had at 6 P. M. received her crew, and been stocked with nearly a thousand pounds of sand-ballast. Her larder also was stored with provisions, water, ice, a bucket of lemonade, and through the interposition of some kind friends, a basket of wine and sundry well-cooked articles of game.

There was rigged on the stern of the boat a propeller, intended to be worked by manual labor. Messrs. Gager, Lamountane and Hyde took their stations in the boat, and Mr. John Wise, as chief-director, in the wicker car above, into which descended the valve-rope. Everything being now in readiness, the "Atlantic" was cut loose from the earth at a quarter before seven o'clock in the evening. The ascent was



PHOSPHORESCENT APPEARANCE OF THE BALLOON.



LOOKING DOWN FROM THE BALLOON AT NIGHT.

graceful and easy, the balloon moving off in an easterly direction. The cheers of the audience, inside and outside of the arena, were of the heartiest kind. We responded with a parting farewell and a lingering look upon the thousands of upturned faces that cheered us onward.

In a few minutes after we started we were crossing the great father of American waters—the Mississippi. For many miles up and down we scanned its tortuous course of turbid water. Its tributaries—the Missouri and Illinois—added interest to the magnificent view. The clearer water of the Missouri, as it was pouring itself into the capacious maw of the great recipient of the Mississippi Valley, could be traced, by its more brilliant reflection, far into the body of its muddied parent.

The city of St. Louis, covering a large area of territory, appeared to be gradually contracting its circumferential lines, and finally hid itself under a dark mantle of smoke. With the clatter and clang of its multifarious workshops, and the heterogeneous noises of a great commercial emporium, it gave out sounds more like a pandemonium than that of a great civilized choir of music. At greater heights these sounds were modulated into cadences. We gazed upon the fading outlines of the country with sentimental yearnings, as we recurred to the parting farewell of the kind friends left behind, while at the same time our hearts were filled with joy upon the prospects of a glorious voyage to our friends in the East, to whom was already announced the fact of our coming.

The fruitful fields of Illinois were now passing rapidly underneath us, seemingly bound for a more western empire, while we were hanging, apparently, listlessly and passively, in ethereal space. The plantations and farm-houses appeared to be travelling at the rate of fifty miles per hour, with an occasional gyration about our common centre, as the turning round of the air-ship would make it appear.

The "man in the moon," dressed in his new cocked-hat, lent us the light of his silvery countenance for the beginning of our voyage.

In the mellow twilight of the evening we espied Mr. Brooks, a little to the north of our track, in the careful keeping of a crowd of Illinois farmers, among whom he had alighted.

Having now attained a height of 8000 feet, and having settled into a state of composure after the labor and excitement incident to our preparation and departure, I took an observation of the trim and bearing of our noble ship.

The network was constructed in such a way that the increase of meshes was at six different points made in direct lines from the top to the bottom, and this made those parts really shorter than the intervening spaces; consequently, when the cords attached to its lower circumference were fastened to the concentrating hoop by equal lengths, it was found that the whole weight of the balloon's burden was being borne by the six ropes secured at those points; and as the

balloon was expanding from diminished pressure, these six shorter cords were cutting, or rather pressing into, the body of the balloon in a most appalling manner. In a moment I summoned Mr. Gager up into the wicker car, and in half an hour, at the expense of abraded fingers, we adjusted the ropes so that they would receive an equal bearing. There were thirty-six of them.

The feeble shimmer of the new moon was now mantling the earth beneath in a mellow light, and the western horizon was painted with gold and purple. Nothing could exceed the solemn grandeur of the scene. All was as quiet and still as death; not a word was passing from the lips of the crew; every one seemed to be impressed with the profound silence that hung around us. The coy-looking moon was lowering itself into the golden billows of the Occident, and the greater stars began to peep through the curtains of the vasty deep one by one. Still silence reigned supreme. It seemed as though all nature had gone to sleep with the setting of the moon, and the stars were coming out on the watch-towers of the night. In another moment the stillness was broken. Cattle began to low, and some loud-mouthed dogs greeted our ears with an occasional bark. This seemed to break the silence of the crew, and soon a lively conversation ensued. We also amused ourselves by uttering an occasional shout, which set the dogs below to barking far and near.

During the day, and while the balloon was being inflated, the sun was pouring down upon it a flood of heat and light. Although it is a proverb "that you cannot carry light in a bag," it will be learned that this ancient saying found its contradiction in our gas-bag. It did carry up with it heat and light, and during the whole night it was illuminated with a brightness equal to a Chinese paper lantern. It served a good purpose, as it enabled us to note the time by our watches. It appeared, indeed, truly wonderful, and the first impression made was that it might be an incipient combustion, and that soon it might be our lot to pass into eternity like a blazing meteor. The phenomenon was so remarkable that the mind was not at first capable of finding a satisfactory reason for its appearance. However, the conclusion finally arrived at was that it must be a combination of heat, light and carburetted hydrogen; and inasmuch as it had been going on for several hours, it was not likely to get hotter in the upper air, so we satisfied ourselves that there was no imminent danger from a conflagration while aloft.

This phenomenon is sometimes to be seen in the slightly illuminated clouds on a hot summer night. In the balloon it was unique. Every seam and every mesh in the network could be traced upon its surface. Even the atmosphere around and beneath us seemed to partake of this mellow light. Woods, roads, prairies, streams and towns were discernible, and their outlines could clearly be traced at our greatest elevation.

Nothing could surpass the novelty of the scenery below during the early part of the night. The heavens above were brilliantly studded with stars of every magnitude and color, the atmosphere having become

perfectly clear; and when we crossed water, we had the starry heavens as distinctly visible below as above. We could at such times easily imagine ourselves sailing in the very centre of the star region, as the opaque earth seemed then out of the question. These reflected star-fields were of short duration, but vanished only to make room for that weird appearance which the earth presented. One could not immediately see the surface outline below; but keeping the eye steadily fixed downward, it gradually developed itself to the vision, until every different shape and object became defined, though in a most ghost-like light. The forests appeared of a deep brown cast; and when a handful of sand was dropped overboard, at our greatest elevation, it could be distinctly heard raining upon the foliage of the trees. It answered as an index for our altitude, in accordance with the time that elapsed between the discharge of the sand and the noise of its contact with the trees.

The roads presented in appearance pale yellow ribbons, and the fences and ditches as evanescent lines. The prairie flowers at times exhibited their respective colors, as they happened to live in families of blue and yellow apparel in distinct patches. Villages could only be seen as diffused outlines of ground-plots, with here and there a faint point of light, but in the early part of the night we could at times hear human voices in the streets. Our horizon seemed very contracted, vaulting around us, as it were, with an inclination to close upon us underneath. On its northern border there was during the whole night a blaze of light, probably from the Chicago lighthouse on Lake Michigan.

Now and then we would give a shout to attract attention from below, especially when crossing towns, but only the echo of our voices seemed to respond, and these echoes varied in distinctness agreeably to the reflecting surface below.

When the eye was once firmly fixed on the earth, so that the singularly mellowed scenery was fairly unfolded to the sight, it was with the greatest reluctance that it could be drawn away. There was an enchantment in the view. Looking downward, contemplating the earth in its diversified outlines afforded a satisfaction much like that of the astronomer when he is favored with a powerful telescope that enables him to trace the outlines of the surface of the moon. The topography of the earth, taken from such a position as ours upon that night, and under the same conditions of light, would present as marvellous an appearance as does Maedler's map of the moon. Indeed, the appearance of the earth, as we saw it that night, bore no resemblance to a day view of the same. If the scene could be delineated by the pencil of the limner as it then appeared, it would resemble neither a night nor a day-picture of the landscape, as seen from the earth. In the language of Mr. Hyde, it afforded "such an exhilaration of spirit and such a real joy" as seldom fall to the lot of a mortal being.

As in the daytime, the visible portion of the earth developed itself

in a great circle, hollowed out as a vast concavity. Occasionally flashes of lightning illumined portions of the horizon, but these were too distant to bring to our ears the sound of thunder.

It may be observed, for the better elucidation to the reader, that the convexity of the earth, being eight inches to the mile, limits the area of vision to an observer on its surface much within that which is spread out to one who is a mile or two above it. It is a singular anomaly of fact and appearance that while the earth is really globular, it appears to the eye of the aëronaut as a concave. This is the effect of refraction, caused by the variable density of the atmosphere, giving the vision a curvilinear direction corresponding to the angle presented when we place a stick in the water at any inclination from the perpendicular. Light, whether from the rays of a meridian sun or the fainter rays as reflected from the higher portions of the atmosphere, and from the surfaces of the remote stars, obeys this law, moving, as it does, in the direction of least resistance. From this it will be seen that the horizon of the aëronaut always appears as much above its true level as the difference between a straight line from his eye to the true horizon and the amount of curvature caused by refraction to said line. It is only when he looks straight down in a plumb line that the object is really where the eye perceives it. All other objects seen at a point between his perpendicular and the visible horizon are really below the point at which he sees them, and hence the concave appearance of the earth to the aëronaut.

The day having been very warm, with the thermometer in the nineties, and much labor having devolved on me during the process of inflation on account of the indisposition of Mr. Lamountane, to whom had been allotted that part of the preparations, I began to feel the need of sleep, if only of a short nap. Wrapping around me several blankets, I fixed myself for a short repose as well as the contracted area of the car would permit. The balloon was not fully distended, and the hose that was fastened to its neck, and which acted as a safety-valve for the escape of gas, when it became fairly filled out by rising up into a thinner atmosphere, was hanging over the edge of the car. Thus prepared for an intermission, I gave directions to the party in the boat below to keep the air-ship well up, as that would give us a more direct easterly course. In accordance with these instructions, a liberal disposal of ballast was made during my sleep. This sent up the balloon to a height where the diminished density of the atmosphere allowed the gas fully to distend it, and thus drew the hose into the car and immediately over my face, thereby discharging the gas into my mouth and nostrils.

Mr. Gager, having occasion to make some inquiries concerning the management of the craft, addressed himself to me. Getting no reply after repeating his interrogations three or four times, and noticing that I was breathing heavily and convulsively, he became alarmed, and as quickly as he could mounted up into the car. Lucky it was for me

"PHŒBUS WAS BEING USHERED IN, CLAD IN HIS MOST GORGEOUS APPAREL."

that he was so watchful and considerate, for a few minutes more would have ended my existence, from the copious overflow of gas that had ensued. He removed the hose from my face and raised up my head; and after a few minutes' inhalation of purer air, my consciousness gradually returned, but not without strange and disturbing visions flitting through the brain. It seemed to me the awakening from a long and profound sleep—a sleep of years, during which I had dreamed of great diving-bell experiments and interplanetary balloon voyages.

Not until I rose up upon my feet, and caught hold of the ropes of the balloon, did I become fully conscious of my whereabouts. Upon addressing Mr. Gager concerning the propriety of lowering the balloon into a more genial temperature, for the air at that height, about 12,000 feet, was quite chilly, he remarked, "Richard is himself again, and I am glad. Now, professor, I hope you will keep wide awake the remainder of the night." I assured him I would; and when he got down in the boat, I suggested that the party might take each a nap if they felt so disposed, as I would keep the air-ship in trim during their repose. A few minutes later I heard some healthful snoring going on below, though Mr. Hyde averred that he kept an eye open the whole of the night.

The balance of the night was employed in various experiments and observations. We had learned that the country watch-dogs were ever ready to respond to any inquiries in the shape of "halloos" from above. The paucity or copiousness of their answering bow-wows served as indices of the sparseness or fulness of habitations in the locality over which these demonstrations took place. Sometimes a hundred canine voices would come up at once, and then a village or thick settlement was indicated below. At another a single bow-wow told us of the lone log-cabin in the wild woods; and again the adjacent farms of the prairie were indicated by a medley of canine choruses..

It might naturally be supposed that sailing through the air a mile or two above the surface of the earth, during a moonless night, would be a dull and dreary pastime. Such, however, is far from being the case. From the foregoing description of the earth as seen in its night delineations, and the intercourse that was kept up with animated nature below, although it was mainly talking to dogs, it will be seen that the subject was interesting enough to an ordinarily philosophic mind.

Striking during the night over the bend of a river which our chart indicated to be the Wabash, and which lay in our course for a considerable distance, the scene was truly grand. We were surrounded by stars and milky ways. Above, below and all around us the vigils of heaven were twinkling their diamond-like clusters. One, which for a moment brought to mind that of the constellation of the fishes, drew our attention particularly. Upon nearing the object, it revealed itself as a midnight fisherman lifting his net, and a lively haul it proved to be. We could see, by the light of his lantern, the fish bouncing about in the bottom of his boat. We hailed him as we passed over, and con-

gratulated him upon his good luck. He betrayed a great deal of amazement, looking this way and that way, then into the water, and again his eyes were directed toward the shore. He looked every possible way but upward; and as we were pleasantly discussing his consternation in his hearing, it is no wonder that he felt perplexed and surprised.

After we left the river we passed over a town, and could distinctly hear a *trialogue* between a party of bacchanals upon the probabilities of their reception at home at that hour of the night. We hailed them to go home, and then all was hushed in silence below. No doubt the maudlin party took the admonition in a serious mood, and they were in all probability as much surprised as was our fisherman friend on the river at these mysterious voices.

We followed the course of the Wabash River from Williamsport to Logansport, Indiana. The water had the appearance of a dark plate-glass mirror, and the brilliancy of the starry reflection from its surface, bounded in its outlines by the banks of the river, gave it the appearance of a "milky way" far more beautiful than the real one in the heavens above. Nothing could surpass the loveliness of this midnight landscape scenery, diversified with water and prairie, woods and villages, farms and flower-patches.

As the small hours of the night were passing away, we saw the gray of the morning making a faint appearance on the eastern horizon. The view at first resembled that as seen in mid-ocean on a calm summer morning before sunrise. The sky was cloudless, and the wind upon which we were riding was one of those peculiar high barometer winds that course across our continent from west to east, a little northeast. These are the carriers, if not the propagators, of our cyclones, and they give rise to the tornadoes and hurricanes we experience through the hot summer months. We realized this, much to our discomfort, as the sequel will show, in effecting our landing on the second day of our voyage.

A little while before the sun made its appearance, and when the dawn of the morning was changing the night scene of the voyage to that of day, we passed by the city of Fort Wayne, leaving it a little to the south. We were low enough to see several railroads converging toward the western extremity of Lake Erie. The country around, as far as the eye could reach distinctly—and that was over an area of forty or fifty miles in diameter—was filled with farm-houses, and the fields were well stocked with horses and cattle. In order to get an earlier view of the sun, the balloon was lighted of a quantity of ballast sufficient to raise it four or five thousand feet higher. It was not many minutes before a scene of the rarest beauty began to unfold itself in the eastern heavens. Phœbus was being ushered in, clad in his most gorgeous apparel. Words will entirely fail to depict the grandeur of the sunrise. The mind became overwhelmed with the intensity and brilliancy of the spectacle, as the sun was being quickly lifted out of the fiery deep by the rapid ascension of our point of view. We had now

approached near enough to Lake Erie to receive the full force of reflected and refracted light from its great surface. Various conjectures were given by our party in explanation of this singular phenomenon before we saw the lake. One surmised that the heavens were on fire, and that the phosphorescent illumination of the bygone night had been the harbinger of the world's conflagration. Indeed, the heat of this powerful reflection was smarting our faces. It seemed as though we were running right into the sun. The horizon appeared to be bounded by a lake of white-hot metal, and it was some time before I could find a sufficient explanation for the wonder before us. I finally suggested that it must be the illumination of Lake Erie, as we must be approaching it rapidly. To this the general assent of the party was given, especially when I stated that I had seen its reverse in a sunset scene while over the lake with a balloon, although in that case the effect was not nearly so brilliant.

This warmth of direct and reflected sunbeams soon began to tell on the balloon; and finding it to swell out rapidly, causing such a sudden unfolding of its great pleats as to make it sound like ripping open a heavy canvas, I made a liberal use of the valve. This brought the air-ship to a lower level, with the sun several degrees above the horizon, and with it a corresponding expansion of the lake of fire before us. Now, since balloons are very sensitive bodies as to atmospheric density and to heat and cold, and thus very easily disturbed in their equilibriums, so that in the discharge of a little too much gas a retrograde motion is given downward, we found ourselves approaching the earth again and the sun sinking down with us, until its immensely-expanded disk looked ten times larger than usual, as it was resting a little above the horizon. In the mean time a bank of bright purple striated clouds had settled around the god of the morning, and we were thus relieved from the heat and reflection incident to a higher altitude. The scenery below had now become remarkably fine. The mellow, early sunlight made immensely elongated shadows of the woods and isolated trees in the fields, as well as of the buildings, and the stacks of the crops that were garnered by the husbandmen. It was a glorious morning scene; and although something had been whispered about a warm breakfast, that formality was dispensed with from the idea that the time was too precious, and that each one might lunch according to his personal convenience.

We were now moving along the course of the Maumee River, a tributary of Lake Erie, and so near to the earth as to be able to hold conversation with the people inhabiting the country we were passing over. The people were, however, very reticent. Rarely would they answer, although we could occasionally hear the shout of "balloon." The horses and horn-cattle grazing in the pasture took the alarm from the balloon as it drifted toward them, and its ghost-like shadow seemed to terrify them still more as it flitted across the green fields. With tails erect and manes streaming in the breeze, they gave us many

amusing equestrian and bovine displays. The horses and bullocks getting on the rampage did not fail to send the infection upon the men and boys engaged in the early field work. The boys made for the barns and the haystacks, but the full-grown men stood the surprise a little better, though many of them turned us the cold shoulder when we questioned them. Some of them looked at us for a moment, and then ran away. One more courageous than the others answered our question as to where we were at the moment by saying, "You ought to know that yourselves; where did you all come from so early this morning?" A little farther on the same question was answered by saying, "You are not on the world—you must be going to heaven; what are you going to do with that boat?" Still another as we passed along answered, "You are in the sky, and you are going straight for Lake Erie," to which we replied that we knew all about that part of the business. Passing directly by an extensive group of farm-buildings where the whole family had come out to see the approach of the balloon, we shouted the compliments of the morning, which was responded to by a general and enthusiastic greeting, followed by a chorus of invitation to "Come down, oh come down!" On asking this party whether we could be accommodated with a cup of coffee if we should make a landing, we received the earnest answer of, "Yes, plenty of hot coffee for you all—anything you want;" and upon this a general stampede for the balloon was made, as we had descended very low in order to effect a temporary landing and procure a warm breakfast. Upon a deliberate consultation, this idea was abandoned, as we were moving at a very rapid speed which might render the landing a difficult experiment. A small steamboat was coming up the Maumee River, and nearly underneath us. The captain blew his steam-whistle, rang the boat-bell and prepared to lay to, and then invited us to come down. "Lake Erie is right ahead of you," he cried, through his speaking-trumpet. Another excited individual, with broad-brimmed straw hat on and in his shirt sleeves, with a rake in his hand, ran vigorously along the track of the balloon, crying most lustily, "You had better come down, for you are going right into Lake Erie, and you'll all be drowned."

At a quarter before seven in the morning we passed out over Lake Erie, with Toledo to the north-west and Sandusky to the south-east of our course. Before us the lake was dotted with islands, and its shores presented a ragged appearance. Heavy clouds were forming to the south and east of us. Ballast enough was now discharged to carry us up above the cloud-level. This obscured from our view the southern shore of the lake. Beyond its northern margin the land looked inhospitable, so we were contented to make almost a bee-line down over the middle of this interesting sheet of water. Its surface was ruffled with spray, and the waves were heaving on its bosom. At the rate at which we were now sailing, about sixty miles an hour, we calculated to reach Buffalo about eleven o'clock A. M. We could discern but few

vessels moving on the water. Passing nearly over one, the captain hailed us with his speaking-trumpet, asking where we were from and whither we were bound. I answered him that we were from St. Louis, and that we were bound for Buffalo direct, and then as much farther as we could get. He continued the conversation, but we had so far outstripped him that it was impossible to make out what he was uttering, as we rose to a greater height.

Sailing at an altitude of 10,000 feet contracted our area of visible surface below so much that we thought it would be more interesting if we should lower the air-ship to within a thousand feet or less of the water's surface. So down we came until we nearly touched the waves. Overhauling a steamboat that was moving in the same direction with us, we struck up a conversation. The steam-whistle was sounded, the boat-bell rung, and a speaking-trumpet conversation ensued: "How do you do, captain? A fine morning for boating." The captain immediately responded, "Good-morning, my brave fellows; but where in the heavens did you come from?" "From St. Louis, sir, last evening." "And pray where are you going?" "Going eastward, captain; first to Buffalo, and then to Europe, if we can." "Good luck to you," said the captain; "you are going like thunder."

We were now only about 500 feet high, and in half an hour after our colloquy with the captain of the steamer, we beheld his craft dancing in the verge of the western horizon. He was travelling about twelve miles per hour, and we at least sixty; and as we parted, leaving him behind, it seemed as though he was sailing to the west, while we were moving eastward.

Our trip of two hundred and fifty miles down over the lake was the most monotonous of the whole voyage. Nothing but water and sky was visible most of the time, as the clouds had settled in thick masses around us, and thus obscured the shore entirely on the south side. The first distinct view we got of land was as we crossed "Long Point," jutting out from the Canada shore, and on it we could see the poles sticking in the sand that defined the ground of the great prize-fight between Morrissey and Heenan for the championship of America.

We passed along near the mouth of the Welland Canal, and gazed over the Canada shore. Desiring to make more to the south, the balloon was suffered to rise, with the hope that we should find the current trending to the south-east, and this soon brought us into full view of Buffalo, Niagara Falls, Lockport and Lake Ontario. Niagara River looked like a silvery cord linking the two lakes together.

## CHAPTER XLII.

Niagara Falls as seen from the balloon—A cloud manufactory—A storm brewing—Caught in a tornado—Between two boisterous elements—The landing—Public reception of the air voyagers.

NIAGARA FALLS was deemed rather a tame sight by my companions as viewed from our position. We were 10,000 feet high as we crossed Goat Island, and a bottle of Heidsieck that was uncorked in honor of the world-renowned cataract made more of a commotion and a livelier spray than did the falls, to all appearance. Mr. Gager observed that it was "no great shakes, after all." Mr. Hyde thought it looked "frozen up." Mr. Lamountane said it would do for a clever little mill-dam—water-power. I felt inclined to play the part of Indian; and as Black Hawk said when I made a balloon ascension for him and his chiefs, at Ninth and Green streets, in Philadelphia, that "he had seen that kind of thing before"—which really was the truth, as he had seen one ascend from the Battery, in New York, a year or two previously—I said, "Gentlemen, I have seen this thing before, and you will find some peculiar and interesting phenomena connected with this Niagara waterfall, if you will but listen and observe it more closely.

"Do you see what a wonderful cloud manufactory this Niagara is? Cloud upon cloud is rising up from its evaporized water. See how orderly they take up their line of march eastward, as they rise up, perhaps to carry their treasured moisture to some distant parching land. It is a sublime spectacle this—a laboratory of Nature—an irrigating engine. Nothing is formed in vain. And now listen to its music. It is not a roaring, thundering, dashing, tumultuous sound, but a music of sweetest cadence. Like an æolian harp it sends up its vibrations. If it is not the music of the spheres, it is at least the rhythmic language of motion, wherein we perceive that noble proverb illustrated that 'order is Heaven's first law.'"

All great noises proceeding from the earth, and reaching the ear when one is in the air some 10,000 or 15,000 feet, act upon the acoustic organs with measured accent. It is an interesting and charming phenomenon, and never fails to elicit the admiration of the observing aëronaut. An ordinary mill-dam plays this music to the ear of the


"WHAT A WONDERFUL CLOUD-MANUFACTORY THIS NIAGARA IS!"

air-sailor as he passes over or nearly above it. And the heterogeneous noise of a great city gradually merges into vibrations of harmony, as it comes up to balloon heights.

Several beautiful miniature rainbows were displayed over the falls. These gave the place a fairy-like appearance. Although the cataract looked contracted in its dimensions, and the motion of the water could not be seen, still, its surroundings and the attendant phenomena above described made the spectacle a very interesting feature of the voyage. The proximity of the two great sheets of water of Lakes Erie and Ontario, with the life-teeming country between them, was of itself a magnificent sight. Buffalo presented a beautiful appearance, swinging, as it were, at the eastern extremity of Lake Erie. Its harbor was lined with water-craft, and the smoke of its manufacturing establishments was curling up from a hundred chimneys.

Fort Erie, Fort Niagara, Brock's monument, Lewiston, Lockport, Black Rock, were all in view. Indeed, there was so much of interest to be seen at one time that it was difficult to dwell upon any single sight without losing a great portion of the whole scene, for we were moving very rapidly over the land.

I mentioned before that we were riding the advance wave of a coming great storm, and the sky all around us was assuming the certain characteristics of its near approach. Heavy cumulus clouds were forming out of the agitated and compressed atmosphere, and this had much to do with the rapid formation of vapor from the rising spray of Niagara Falls. Although the sun was still shining through the blue spaces that were unclouded, the air between and above them was assuming the peculiar milk-like appearance that indicates the incipient rain-forming condition of the atmosphere.

Just as we were passing over the most interesting places of our voyage, the condition of the weather and the limited amount of ballast yet remaining on hand caused a solicitude for our future welfare that absorbed nearly all my thoughts in the contemplation of what course it was best to pursue. My three companions were not fairly conscious of the pending storm, nor had they the slightest conjecture of what was revolving in my mind, for I spoke little, and kept thinking as hard as I could.

Mr. Hyde had never before been up with a balloon. Mr. Gager had made but one ascension heretofore. Mr. Lamountane had but a novitiate's experience in half a dozen aërial voyages I had conducted for him, but his experience as a practical seaman made him more proficient in the management of sailing paraphernalia, and probably in the prognostication of weather, although he expressed no particular solicitude as to the war of elements in preparation around us. It is a trite saying that "misery loves company," but really, in this case, I would much rather have been alone, as then I could have acted more decidedly upon the emergency of the moment. As the reader may well appreciate, moments are of great value when you are drifting along at

the rate of a mile and a half per minute, at which velocity we were now moving.

My companions in the boat were engaged in cheerful conversation upon the scenes passing before them on all sides below—the grand panorama of the two great lakes, with innumerable cities and towns in full view, with railroads and canals on which were trailing sundry snake-like lines of moving trains, with all the concomitants of a thickly-populated district, and silvery lines of tortuous watercourses, interspersed with the golden patches of grain-fields, garnished with the music of steam-whistles, ringing of bells, firing of guns, shouting from a thousand throats; indeed, the country below had become thoroughly alive for many miles to the flitting of the air-ship among the clouds, as it could now be quite plainly seen from below. The sight of the balloon seemed to arouse all the extemporaneous expedients immediately at hand to be brought into play as a salutation of the new-born mode of travel, for by this time the ubiquitous telegraph had informed the public of the United States that the balloon "Atlantic" had started from St. Louis yesterday at eve, bound for New York; and in the realization of this fact as now witnessed, this extraordinary demonstration was elicited, and by sympathetic action was rendering our party truly alive to its exhilarating influences. I was almost constrained to banish from my mind the forebodings prompted by the elements around us. For a moment I thought to join in the general exultation, in the consolation of sufficient to the hour is the evil thereof. But, again, I was acting as "director-in-chief;" and having assumed all the responsibility of the position, I could not satisfy myself to keep my apprehensions of the danger to come locked up in my own thoughts. I hesitated to say, at this juncture of affairs, that we were sailing between life and death.

We had now got into full view of the city of Rochester, and the balloon coursing her way to Lake Ontario. Mr. Gager, who I observed had been closely scanning the land below, now addressed himself to me, in his usual cheerful mood, in the following words:

"Professor, what keeps you so quiet, and what in the world makes you look so contemplative?" To which I replied, "Did you perceive anything extraordinary below when you looked so earnestly earthward?" "Yes," said he; "I could see that the wind was very strong below, and I could hear the limbs of the trees crack as if they were spliting from the trunks; but," said he, further, "I was just thinking that we might effect a landing near Rochester, leave Mr. Hyde and myself off to take our mail down to the city of New York, while you and Lamountane pursued the journey as much farther as you wish."

"All very well considered, my dear friend," said I; "but do you see the fences being blown away into the air, the grain flattened down to the ground, and the trees bending their tops in acknowledgment of the powers of the air? How do you think our fairy vehicle would stand such usage?"

"True enough," said Mr. Gager; "there is considerable of a breeze below there, and I see we are moving at a tremendous rate of speed; but what's to be done? Our ballast is spun out."

In the mean time, Hyde and Lamountane had also become engaged in a close observation of the state of things below. The situation had by this time developed itself to the understanding of the whole party, and this, to some extent, calmed the emotions of my mind as to how I should open the question to my companions. With all this rapid speed of the balloon, and with all the commotion in clouds of dust below, and the miniature performances of the whirlwind on the surface of the earth, in our position there reigned a dead silence, and the fibre of a cobweb would not have been ruffled if suspended in our car or boat at the height we were still sailing.

It was a remarkable illustration of two very opposite conditions, wherein the mind could not fully become alive to the noise and force of nature as going on below, on account of the profound stillness that surrounded us above.

Feeling now at ease to make any suggestions regarding the situation in which we were placed, I proposed a consultation as to the most expedient means of safety. The first idea suggested was to attempt a landing, and some or all of us to get off, as circumstances might afford. To this I should most readily have assented could it have been even possible for the three in the boat below, which would strike the earth first, to make their exit, as then I should have regained sufficient power to rise up high above the tornado, and by that manœuvre to escape the line of its track. The balloon was now gradually settling down, and our sand ballast was all gone; nothing but the propeller gearing, which had been dismounted and was lying in the bottom of the boat, could now serve us to escape contact with the earth.

When we had descended far enough to hear the crashing of the trees and the rumbling turmoil of the tempest, and could discern more vividly the rushing speed of our silken-bodied ship, we became truly sensible of the difficult task of jumping ashore, as was proposed.

Lamountane cried up to me at this moment, with emphatic voice, "Professor, what's to be done?"

"Throw everything overboard that you can lay your hands on," was the reply, "or we shall be torn to pieces if we strike the ground."

Overboard went the machinery in a hurry, and in a few seconds was heard to thud as it struck the ground. This enabled us barely to clear the tree-tops of a piece of woodland over which we were passing, and in a few moments thereafter we were mounting upward once more.

The question was again asked what had best be done, to which I replied, "Be prepared for the worst; the prospects before us are dismal enough." On this the other question followed, "Is there any great danger of our lives?"

"Yes," was the unequivocal reply; "I see no earthly chance of a clear and safe alighting, unless we take to the water." The chance be-

tween drowning and that of being mangled into mincemeat among the rocks and trees was enough to appall the hearts of strong men; but a more noble trio I never beheld than the men in the boat. Almost simultaneously issued from their lips the cry, "As long as there is life there is hope; so let us do the best we can."

"Well said, my brave companions!" was my mental reply.

Now came the trying time of our voyage—it may be safely said of our manhood. I called Mr. Gager up into my car. When he got up and seated himself by my side, he seemed quite composed. He broke silence by asking me in a serious manner what I really thought of the prospects before us. It must be remembered by the reader that we were still sweeping smoothly along, and everything painfully quiet, but with the moral certainty that we should sink down on the angry billows beneath us before we could reach a shore more than a hundred miles ahead.

I told Mr. Gager that it seemed to me best to swamp the balloon in the lake, if we should be fortunate enough to intercept or to be intercepted by some craft. While thus engaged in conversation, the balloon was nearing the water, and in order to keep her up, my valise and several bottles of champagne given us by a friend in St. Louis, to be drunk when we landed in New York, were thrown overboard. Away went the valise, with all my clothing and a silver cigar-case presented me by a friend when we started. Next went the wine; but as Mr. Gager was about throwing over the last bottle, and the descent of the balloon being checked, I proposed to open it for refreshment. I handed Mr. Gager my penknife, with which to pry off the wire; and when I perceived that he was sawing with the sharp edge of the blade, I admonished him not to ruin the edge of the knife. He turned up his eyes in a very characteristic manner, and said, "Do you expect ever to have use for this knife again?"

"Certainly I do," was the reply.

"Then," said Gager, "you don't calculate to die very soon?"

"No, my dear friend," said I; "I have an abiding faith that I shall get out of this with life and limb; but cannot really say why I think so, for the chances are very much against us." I further said, "If you have any preparations to make for the other world, you had better make them now, as our time is growing short." In the mean time, Mr. Gager had poured out a cup of wine and put it to his lips, but without drinking handed it to me, with the remark, "I can't drink it." I drank the wine, and threw the bottle and cup overboard. This left us with nothing more disposable but a hatchet and the grapnel and rope.

I rose up from my seat to look down after Hyde and Lamountane. Hyde was sitting in the boat with pencil and paper in hand, but whether to make notes of the voyage or to write his last will and testament I could not tell. I requested him and Lamountane to come up into the car, as we would soon be dashed into the billows of the lake.

"WE WERE BETWEEN TWO BOISTEROUS ELEMENTS."

Mr. Hyde says in his account, truly, "For me a lifetime was concentrated in that awful, perilous moment. I looked round on my companions: they were calm, but their countenances gave me no assurance." Hyde now mounted into the car, but Lamountane remained in the boat. I again requested him to come up and we could cut the boat loose, and by this means be able to rise up again. On this, Mr. Lamountane suggested that he would cut out the double bottom of the boat first, and thus get rid of it piecemeal, and as the emergency of the case might require. I handed him down the hatchet; but before he got well under way of cutting out the bottom, the boat was dashed violently on the water. For a moment it seemed to be grappled by a foaming wave, and in the next instant I saw Lamountane's hat rolling over in the white cap. I exclaimed, "Lamountane's gone." The words had hardly left my lips before I heard the voice of our heroic companion sing out, "No, I'm not; it's only my hat." He was lying in the bottom of the boat, with his arms clasped around one of the cross seats.

After a short struggle, the balloon made several bounds over the waves, and then rose up some six or eight hundred feet. Getting afloat once more, our sailor hero was enabled to complete the removal of the rest of the double bottom and to get it overboard. After that was done, he came up into the car. The boat had her side stove in, but the heavy canvas jacket which encased it kept it water-tight.

The storm clouds had now gathered thickly around us, and we were running low. The scene was fearfully dismal. We were between two boisterous elements that seemed at that moment to be contending for the mastery. The lake was surging and foaming like a thing of wrath. The heavy black clouds above us were frowning down upon the crested billows, and lashing them into a perfect fury. The clashing of the elements filled the air with vapor, as does the smoke of the battle's cannon. It seemed as though the heavens were falling down and our air-ship was endeavoring to wedge itself through, as we were skimming over the watery foam.

Once more I broke the distressing silence of our party by saying, "I think I see a steamer in the distance crossing our track. Let us swamp the balloon, and trust to the chances of being rescued by it. What say you to this, gentlemen?"

"No, no, no!" was the response.

Lamountane complained of being sick and unable to stand the water. Mr. Hyde said, "If we are to die, let us die on the land if we can reach it." Mr. Gager expressed the same sentiment, and added, "We will try and rough it through." I had admonished them before this that in the event of our reaching a wooded country in this tempest, destitute of the means to lift us above the trees and rocks, we were in danger of being dashed to pieces.

All eyes were now gazing intently forward—all hoping, almost against hope itself, that some relief might come to hand; anything else than black clouds and foaming billows would relieve the intense anxiety of

the past hour. Minutes seemed to the mind as ages. It was like a dream that was not all a dream, and yet in the next moment we might wake up in another world. In another moment something was seen to emerge from the thick mist. The propeller Young America hove in sight. As she neared us, my heart throbbed with emotion at the thought of losing the golden opportunity. In swamping, our boat would have filled with water and formed a dead drag, and with our car in the same plight, we might easily have been fished up with a line thrown us from the steamer. I had experienced that kind of rescue before by being picked up by a brig on Lake Erie. I said,

"Well, boys, if you will not be saved in the water, let us get ready to return the salute of the steamer," for by this time its bell was ringing out its lusty peals, its steam-whistle was piping its shrillest notes, and all its passengers were paraded on the forward deck to cheer the aërial craft. The ladies waved their handkerchiefs and the men began to hurrah. This cheered me up, and I said,

"Now, boys, for a hearty hurrah, if it should be the last one of our lives."

We made the effort, but such a sickly hurrah I never heard before. Indeed, it sounded to me like the death-notes of a forlorn hope. The people on the boat thought without doubt that we were going along nicely enough. Little did they dream that we were sailing with death-warrants in our hands.

We had now drifted for a hundred miles or more just above the tempest-tossed water, occasionally thumping against its angry billows, and no land to be seen yet. Going with a velocity of at least a mile a minute, the idea of striking the shore seemed to afford but little hope of our safety. To me it was far more terrible to contemplate than was the necessity of going out upon the water as we left the last land. To my companions it was a solace when I assured them that we should surely reach the shore in less than half an hour, as I knew we were approaching the eastern limit of the lake.

It was just one o'clock and thirty-five minutes P. M. when land loomed up in the distant east. Mr. Hyde cried out, in a hopeful voice,

"I see land, but it seems a million miles off."

"Too near for our comfort," was my reply.

I bade the men take good hold of the rigging, as it was my determination to swamp the balloon some hundred yards before it reached the shore. I suggested at the same time that one should be appointed to jump from the car as soon as it touched the land, as there was a dense wood before us, otherwise we should be dragged through the tree-tops and be torn to pieces. To be sure, the ropes and nettings were very strong, and I had taken the precaution of hooping our concentrating ring with iron, to which all the ropes of the balloon and the car and the boat were fastened, as also the rope of the grapnel.

Now, had the plan of leaving one of our crew out on reaching the shore succeeded, the balloon would have risen to three miles' height,

"THE BALLOON WENT CRASHING THROUGH THE FOREST."

drifted out of the main trail of the storm, and landed us finally on the shores of the St. Lawrence. But Fate willed it otherwise, and before I could bring the air-ship down to the water-level, it thumped with a violent crash upon the margin of the shore. Instantly I threw out the grapnel. This was made of bar iron, and an inch and one-eighth thick.

The balloon rebounded from the earth and shot up over the tree-tops; the grapnel caught in a tree, but it was like Leviathan tied to a fish-hook. A sharp jingle of breaking metal followed, and in another moment the balloon was dashing along through the tree-tops like a maddened elephant through a jungle.

Our grapnel was made useless, and as the balloon went crashing through the forest the iron-rimmed hoop cut away the branches. It now became evident that a balloon has a tremendous power when propelled by a swift wind. Limb after limb was torn from the trees in which the rigging happened to become momentarily fastened. Bound upon bound went our air-ship. It would plunge from one point of the forest to another, and ever and anon we would all be thrown in a heap to the bottom of the car. It appeared almost past belief that we could survive this dashing and crashing process for a minute longer, but still onward plunged this furious enginery of the air. Once the car had become fastened in the fork of a tree, and there the silken demon was held, swaying to and fro like a meteor of destruction. The folds of the half-emptied balloon were cracking and flapping most fearfully. The wind was piping its shrill notes through the cords and network. Not a word was uttered by any of the crew while this fearful suspense lasted. Each one was holding on with a desperate grip for life.

In another moment a limb of the tree seven or eight inches thick was torn from its trunk, and was swinging in the rigging of the balloon. Another squall, and the air-ship bounded out of the woods and lodged in the side of a high tree, with the limb still hanging to it, and then collapsed. It split open in a number of places, and some of the pieces were carried off high in the air.

We had now sailed over six degrees of north latitude and over sixteen degrees of east longitude, making the longest aërial voyage that has ever been made. The distance from St. Louis was variously computed by our surrounding friends from a thousand to twelve hundred miles. Taking the curve line of our course, it would measure about twelve hundred miles.

Here we were, hanging on the side of a tall tree, our boat still fastened by three ropes at one end of it, suspending it at an angle of about sixty degrees. After stretching our limbs in order to learn whether any were broken, to our joy we found that nobody was hurt. Our garments only were a little the worse for the wear. A party of about half a dozen people standing near by had watched our coming, and were as much astonished as ourselves at this final result of the flight. An elderly lady with spectacles made the remark that she

was really surprised and astonished to see so sensible-looking a party as we appeared to be ride in such an outlandish-looking vehicle. She anxiously inquired where we came from; and when told from St. Louis, she wanted to know how far that was from there, and when informed that it was over a thousand miles, she looked very suspiciously over the top of her spectacles, and said, "That will do now."

Our landing was effected—that is, when we had clambered down on the inclined plane of our boat to the earth from the elevated lodgment in the tree—on the place of Truman B. Whitney, in the township of Henderson, in the county of Jefferson, in the State of New York, at thirty-five minutes past two P. M., July 2, 1859. It was within a few hundred yards of a settlement and among a hospitable people. Everything that could minister to our immediate comforts was generously proffered, and by special invitation we repaired to the house of Mr. Justus Wayne, where a substantial repast had been prepared for us.

After dinner we were provided with vehicles to repair to the town of Adams, nine miles off and on a line of railroad and telegraph wire. Upon our arrival at Adams it was not long before the whole town was alive to the rumor of an extraordinary event. Some wag had started the story that a piece of the moon had fallen down, and that it had been brought to town on a wagon. The people of that place having witnessed a brilliant meteor a short time before gave some credibility to this story. It was not to be wondered at that funny stories should be invented by weak-headed incredulity, when it is considered that the best-minded people of the town shrugged up their shoulders and shook their heads negatively when informed that a balloon party of four men had arrived near that place from St. Louis, Mo., in nineteen hours' time.

Great was the pressure to see the veritable persons; and when a newspaper published the day before in St. Louis was handed to the spokesman of the audience, the doubts of the matter and the strange stories already afloat gave way to a more sober inquiry. The telegraph had flashed the report all over the Union that the balloon was on that route. Some of the prominent men of the place thereupon made a brief proclamation of the matter as evidenced by our documents and the answers we had made to many questions, and proposed to call a town-meeting in their public hall in honor of our arrival.

It being announced that the veteran aëronaut Wise and his aëronautic companions would hold an audience in the town-hall at early candlelight, and this news heralded through the town with a band of music and a spontaneous procession, had the effect of bringing together enough of ladies and gentlemen to occupy every seat and other available place in the commodious building. A president and secretary were immediately provided. Order being restored in the hall, and a few introductory words spoken by the president, the aëronauts were introduced by the president on the platform. It is unnecessary to say anything of greeting applause, for even the ladies joined with the liveliest emotion in the happy demonstration.

The veteran aëronaut, in checkered pants by six inches too short, but the longest the clothing stores of the town afforded, he having abandoned the tattered pair in which he had been "treed," made the opening speech. Ours is a great country for making speeches, so that even the wayworn travellers of a thousand mile air-voyage on a whirlwind could not escape the custom without assuming a boorish stolidity. Comical enough it must have appeared to the audience to see so grave an individual upon such a noted historical occasion appear in such unique costume, as I can assure the reader it did to me, when for the first time at that moment I realized the grotesque figure I presented. The speech, or rather the narrative of the voyage, was briefly and truthfully made. This was followed by another from Mr. Gager in a most happy style, he no doubt feeling cheered in the change of scene from the previous few hours, and which drew the liveliest demonstrations of applause. Mr. Hyde reluctantly, in response to the general demand, made the closing speech. Mr. Lamountane had remained behind to untangle and secure the aërial apparatus from the tree. In the later part of the evening we took the railroad train for Albany on our way home.

Thus ended the greatest balloon voyage that was ever made.

## CHAPTER XLIII.

Summary of the results of the trans-continental voyage—Will aërial navigation pay?—The utility of the science of meteorology.

WHEN it is considered that the voyage just narrated was undertaken for the purpose of demonstrating the truth of what I had repeatedly mentioned, that in our latitude, and over the breadth of the temperate zone, there exists an air-stream from west to east, and that it was made with an air-sailing apparatus far from possessing the perfection to which this kind of machinery can be brought, it will, I trust, elicit the consideration due to its importance, and to which all new and progressive demonstrations are entitled in this marvellous age of improvement.

I am well aware that the way of the pioneer is hard; hard is it to enlist a general approval of his ideas, and harder still the encouragement that should give impetus to well-founded projects. *Will it pay?* is the first engrossing interrogatory of the commercial world, and in no country more emphatically so than in our own, to any new device that may be suggested. Lardner said ocean steamers would not pay. Morse's friends said electrical telegraph wires would not pay. The wisdom of America, in Congress, for a long time, and only by a convulsion, was *forced to try* whether a trans-continental railroad would pay. The astute wisdom of England said gas-lighting would not pay. From this it can hardly be expected that the project of trans-Atlantic ballooning will be viewed as a paying business in the commercial sense of the term. To this I have simply this offset to offer: Did, or do, the arctic and antarctic exploring expeditions pay? Does Lord Ross' great telescope pay? Do the institutions of learning pay? If the advance of scientific knowledge and the aggrandizement of the human intellect are not paying institutions, I may be pardoned to admit that in its present development the promise of a rich cent per cent. return for the investment in a trans-Atlantic balloon company is yet covered with the uncertainty of the mere money-maker, and he invariably says it will not pay. This class of people are to be pardoned for their backwardness; but when we find fossilized science and conservative fogyism setting foot upon the new-born giant of aërial navigation, that is the unkindest cut of all.

To the allegations so frequently made that it is an extremely dangerous mode of transition, we have the fact before us that the voyage just narrated, and which has been so full of hazard, nevertheless terminated without causing any bodily harm to those who participated in its adventure. Now, if the reader will take the pains to examine the records of history of that eventful second of July as reported in the newspapers, he will find that sixteen sailing vessels were wrecked and lost on the lakes on that very day, and with them a number of lives, while our air-craft rode the storm, and in the end landed us without any serious harm. The remark that it was a miraculous escape will not suffice to prove that it was more dangerous than water sailing, because it was not the first nor the second nor the third time that such seemingly miraculous escapes had taken place with the writer of this narrative. Indeed, it is intrinsic to the nature of aërial navigation that appearances of extreme danger are only the monitions of that instinctive excitement that moves us at all times in all cases of motion that are new and untried, and that require a training of the mind and the body to a proper understanding of their conditions. The balloons that were daily and nightly sent out from Paris during its investment by the Prussians, and a number of them carrying warriors, statesmen and philosophers, and in the main managed by ordinary seamen and inexperienced volunteers, give a plain contradiction to the assertion of its being a dangerous practice.

In view of all these demonstrations, and in the fact that the writer of this narrative has practiced aërial navigation for a period of nearly forty years, and has made 446 clear aërial voyages, and many hundred ascents with the balloon captive, is it not time, in this advanced nineteenth century, that a system of trans-Atlantic aërial navigation should be inaugurated? The courses are laid by natural laws, and it requires nothing more than to place the air-ship upon the wings of the wind, and to take the stream in the atmospheric ocean that will serve to carry it to its place of destination. It is as easy to do as it was for Columbus to make his egg stand on its end.

The science of meteorology, now becoming so useful to the mariner and the agriculturist, depends for its greater perfection upon a thorough investigation of the upper air-currents, as yet so imperfectly understood. When the great aërial tides, sweeping the globe from pole to equator, and from equator to pole, changing their annual nodes in accordance with the declination of the earth's pole to its orbit, shall be properly understood, we may be enabled to predict the character of the seasons with even greater accuracy than we do at present the daily weather. There are no doubt cycles of weather, as there are cycles of eclipses and cycles of mutation.

We know that one season is not like the other in continued succession, and we also know that at intervals of years there is brought about a remarkable season very much like one known to "the oldest inhabitant" long time ago. Periodic seasons which bring about these rever-

sals of weather are now as little understood as was our present weather signal service a hundred years ago. How important it is to learn these weather cycles will find a ready acknowledgment in the mind of the ice merchant, and the inhabitants that live in narrow valley gorges, and those located near volcanoes and earthquake regions.

The ways of Providence are not erratic, and what now seems to be purely phenomenal and catastrophic in tides and floods and exceptional seasons may be made as comprehensive as are the local "isobars," by penetrating the aërial ocean, and learning its fluxes and refluxes, and the immediate and proximate forces that give them motion.

The learning of these cosmical laws will be more readily realized by the instrumentality of the balloon than otherwise. When we want to find out what abounds in the wilderness, we must go into it. Science must be made more supra-mundane. The very laws of life are more dependent upon what is overhead than upon that which is underneath our feet.

## CHAPTER XLIV.

**Ascension from St. Louis—Formation of a rain-cloud—The balloon in a rainstorm.**

ON the 30th of July, 1859, I made my 231st aërial voyage, in company with my son, Charles E. Wise, starting from Saint Louis, Missouri, at 11 A. M. This voyage was a purely scientific one, and some very interesting and valuable results were achieved.

As we ascended, Saint Louis presented a bold and handsome curve into the river front, with its broad and busy levee, and its hundreds of steamboats moored in echelon along the shore. The city has a characteristic commercial aspect. The various finished and unfinished public buildings, with a rather dingy hue, give it the appearance of an old city, notwithstanding I saw it thirty years ago, with only six thousand inhabitants, while it numbers now not less than one hundred and sixty thousand.

The Mississippi, under the atmosphere of the day, looked like a muddy frog-pond after a heavy shower, and the steamers plying on its mud-saturated bosom seemed to travel about as fast as a water-spaniel in the same element, and appeared no larger than a common yawl, though some of them were belching up volumes upon volumes of the blackest smoke I ever saw, and creating at the same time a resounding clangor with their bells. (Bells always sound full and strong to the ears of the aëronaut; even cow-bells have a loud sonorous clang when heard high above them.) The city is composed of five distinct clusters of houses, giving an appearance of five villages consolidated into one municipality.

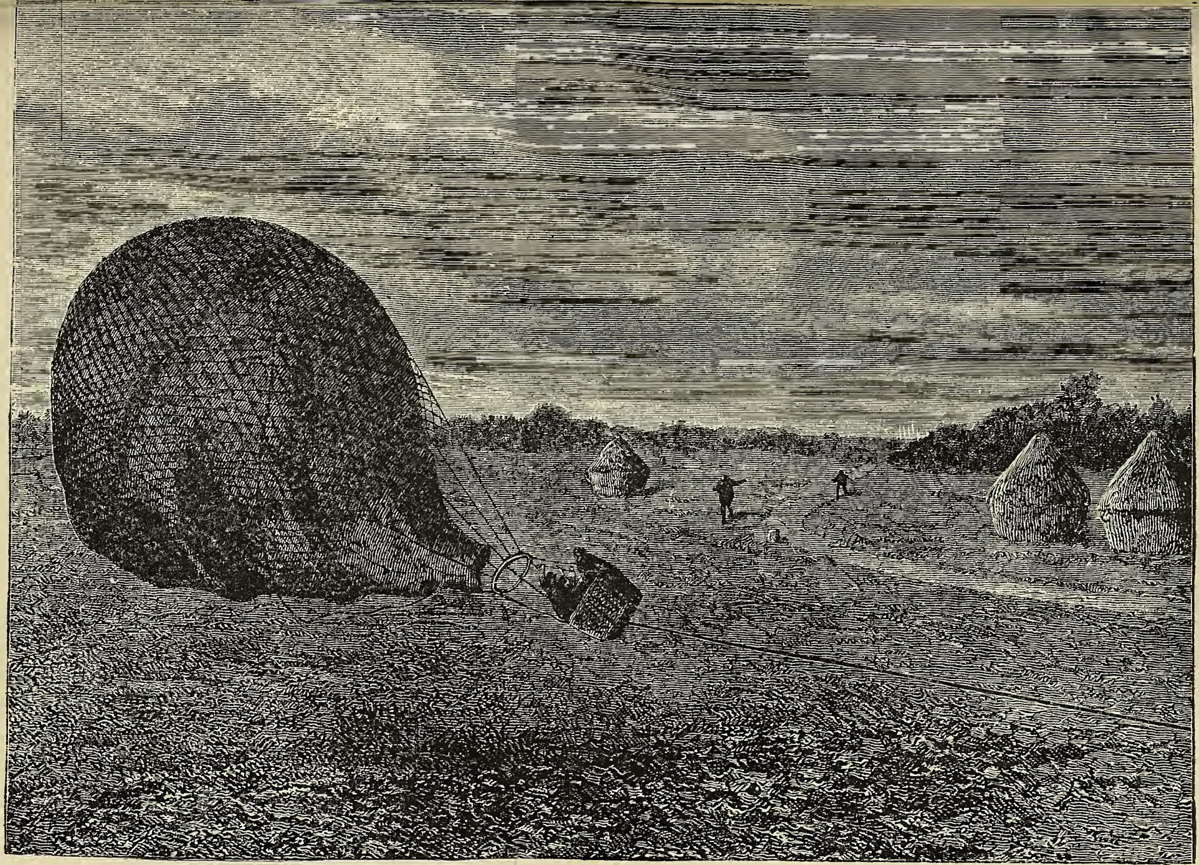
After we had crossed the river in a curved direction, starting toward the north-west, then north, and then north-east as we rose higher, we passed over the lagoons along the Illinois shore. These marshes send up their miasmatic effluvia three thousand feet high. The highlands to the west of Saint Louis swelled up in healthy contrast to the narrow flats below. Bellefontaine Cemetery would have been taken for a gentleman's park, studded with groups of exquisitely white statuary and serpentine gravel walks, had I not been acquainted with its particular locality, five miles north of the city. The loud "toot" of the locomotive turned our heads to the south, where we saw a train of cars "snak-

ing" along through the prairie grass like a huge serpent with a black upturned head, making headway for East Saint Louis. This island dépôt is the very picture of a "death-pot" pestilential morass, and it makes one wonder how such a miserable-looking place could be the terminus of so great a thoroughfare as the railroads that traverse the States a thousand miles from east to west. True it was, the nature of the day made gloom itself look more gloomy.

Having now scanned the city and its environs, we took a look over the great prairies that unfolded themselves to the east. Like a vast ocean, with here and there an island full of trees, does this prairie country look from above. My son remarked that the people along there must have mighty big farms, considering the distances the houses were apart. The impression that this vast domain made upon me at the time was that bountiful nature was extending an invitation to the double-condensed inhabitants of the crowded cities of the world to come and partake of its stores. It is a refuge and a paradise for all who wish to be supplied with food and comforts.

Having now reached an altitude in which we sailed due east, we saw, with compass and chart before us, that Lafayette could not be reached by that current. Our next voyage being posted to take place from that city, we had determined before starting to make a point as near to it as we could. We lowered again, but we plainly saw that the south-east wind below, which drove us a little to north-west at starting, had now supplied the atmosphere with moisture enough to make a growing rain-cloud. Slowly but interestingly the vapor assumed a milky hue. Presently it assumed the appearance of a vesicular cloud; then it spread out and bulged down in the middle, and soon it had the appearance of a great udder, with the water oozing through it, but more copiously at and round about its protuberant centre. It was an interesting phenomenon, and it seemed as though Nature was unbosoming her mammæ to give the thirsty earth some sustenance. I have noticed these udders and water-spouts before, and thus I watched this one more minutely. Above this rain-meteor there was a layer of diffuse striated clouds, with faint sunshine penetrating and warming the balloon, and causing her to rise from expansion of the gas, and this took us up until the barometer fell to 23, and we were sailing east-south-east. This was the highest point we attained, and the thermometer fell to 53, having stood at 82 when we started. Here we uncorked a bottle of water, and it smoked profusely.

Finding now that it was impossible to sail in the direction of Lafayette, unless we sailed in the rain, we tried it for the third time, but we found two serious objections: firstly, it would always saturate the network with so much weight of water as to require a dextrous use of the sand shovel; in the next, the water would follow the surface of the balloon, and running down its neck, would send a torrent on our heads and shoulders. This made it too disagreeable to remain in and under the rain, could we have sufficiently countervailed the depressing



WE WERE TRAILING ALONG THE GROUND.

effects of the balloon by the weight of water thus encountered by the large quantity of ballast we had aboard.

Here I would remark that in order to sail balloons in rain, another concomitant to its paraphernalia becomes necessary. It must be provided with a light water-shedding covering over its upper hemisphere. Such a covering, coming down a foot or two below its equator, would make the whole area within its circumference dry, and thus provide a dry place for the passengers, as well as it would avoid the expenditure of ballast occasioned otherwise by the absorption of rain in the network.

As we sailed in the lower current, and within 500 feet of the earth, we held distinct conversation with the people below, who seemed to enjoy it very much. Some asked where we were going. Others where we came from, how we felt, who we were, and how we liked to ride so high, and nearly all of them finished by wishing us a safe voyage and "good luck to you," while many cried out, "come down," "come down," and finally, when they found that we went on the even tenor of our way, with a wave of our flag as we glided on, they would give us a parting salute by a swing of their hats and 'kerchiefs and a hearty hurrah.

Having sailed under and to the north of the rain by the lower current, and wishing if possible to intercept the Terre Haute Railroad, we at length landed on Ridge Prairie at one o'clock and twenty minutes, about thirty miles north-east of St. Louis, having finally given up the idea of gaining Lafayette in the rain. I now find that this rain reached Lafayette about dusk on Saturday evening, showing that the current would have taken us to or near that point had we remained in it.

We thought of tying up for a few hours when we landed, to see if the rain would not pass over, and then renew our voyage, as we had still 150 pounds of ballast, but in landing we learned another necessity to the perfection of systematic ballooning, to wit, better coming-to machinery. The common balloon hooks or grapnels won't do for the prairie country. Our grapnel caught hold in the prairie sod for a moment, and in tearing up it brought with it a clump of prairie grass, which muffled it so completely that it did not catch firmly after that, and we encountered a drag of half a mile, trying to bring the "Jupiter" to without exhausting her of gas, but we finally had to succumb to the breeze, and exhaust her power through a capacious valve, and thus bring the voyage to a close.

While we were trailing along ground, we were devising means to avoid a recurrence of the trouble. It can be done by fixing four or six claws to the bottom edge of the basket. In addition to this, we plainly saw and felt that if we had a good hickory peg, mounted with an iron socket point, and a hole made through the bottom of the car, we could with one blow of a clever-sized hammer have pinned it fast.

## Statement of Scientific Log.

| Clock. | | | Thermometer. | Barometer. | Direction. |
|---|---|---|---|---|---|
| Start | 11 | A. M. | 82 | 29.3 | N. N. W. |
| " | 11.15 | " | 75 | 28 | N. N. E. |
| " | 11.30 | " | 71 | 27.4 | N. N. E. |
| " | 11.45 | " | 70 | 27.3 | N. E. Rain. |
| " | 12 | M. | 67 | 26.3 | N. E. Rain. |
| " | 12.15 | P. M. | 58 | 24 | E. |
| " | 12.30 | " | 53 | 23.2 | E. S. E. |
| " | 12.45 | " | 70 | 27 | N. N. E. Rain. |
| " | 1 | " | 75 | 28 | N. by E. |

# CHAPTER XLV.

Ascension from Lafayette, Indiana—A bird's-eye view of Grand Prairie—Testing ozone or rhythm of sound—Buzz-flies above the clouds.

ON the 16th of August, 1859, the "Jupiter" balloon was inflated near the gas-works, in the city of Lafayette, and at two P. M. she was moored under an escort of not less than 15,000 persons within the court-house square. When we reached Main street, it became necessary to cross the telegraph wires. In the midst of this dense crowd of orderly persons and a contracted area of high buildings, the balloon got away through extra guy-ropes not having been provided. The ascent was very rapid, and I was without my barometer, compass and chart. Knowing that the time for starting had not arrived by nearly an hour, and the balloon not yet photographed in the square, as it was mentioned in the programme that she would be, I pulled a full valve, which checked her, after attaining a height of 3000 to 4000 feet. In coming down I discovered that something had happened to the valve. I landed in the middle of a street half a mile from the starting-point, and was soon in the hands of the military, under an escort back to the square. Here there was gathered an immense crowd of people, and in their midst the "Jupiter" was photographed by three different artists. Finding that the gas was escaping fast, and feeling desirous of getting the balloon out of the midst of the dense mass of people, I requested my son to step into the car and sail her out of town. He ascended several thousand feet, and in half an hour he was on the outskirts of the city. From this point the balloon was towed back to the gas-works. Here I had the top of her hauled down, and discovered that one of the three india-rubber springs had snapped, and was fixed in under the valve-clapper, causing leakage. This defect we repaired, and with the gas remaining in her—some 8000 cubic feet—she was left standing until next day. It was then announced that the voyage and experiments should be made next day at two o'clock P. M.

At noon, on the 17th, the "Jupiter" was again ready. Inflated about three-fourths full, she carried me with 350 pounds of sand-ballast, besides instruments and provisions. With a good Smithsonian barometer, thermometer, and with paper prepared to test the ozone of the upper air, provided by Chas. M. Wetherill, analytical chemist, I

started under a very calm atmosphere at two P. M. precisely. When I reached the clouds and passed up above them a short distance, I smelled what I inferred was ozone. The barometer stood at twenty-two; and as the thermometer hung in the sun, I omitted its notings, though it ranged from 94° at starting to 66° for the first two hours. After scanning the country round as well as I could through the vast defiles in the clouds below, and remaining poised—*fixed* in space—for more than an hour, all the while over the city of Lafayette, I made the following notes in my log-book. As I have never followed my log literally heretofore in my narratives, I will in this case give a portion of it as written aloft, designating the same by quotation marks:

"While up in the lonely, heavenly regions of the clouds, feeling pious and gladdened, the thought occurred to me that my friends below wondered why I was not going on my voyage east. I thought so myself, but what can I do? 'Jupiter' as full as a drum—no wind—not a breath. How gracefully the distended globe swings to and fro! I am hungry—food tastes delicious.

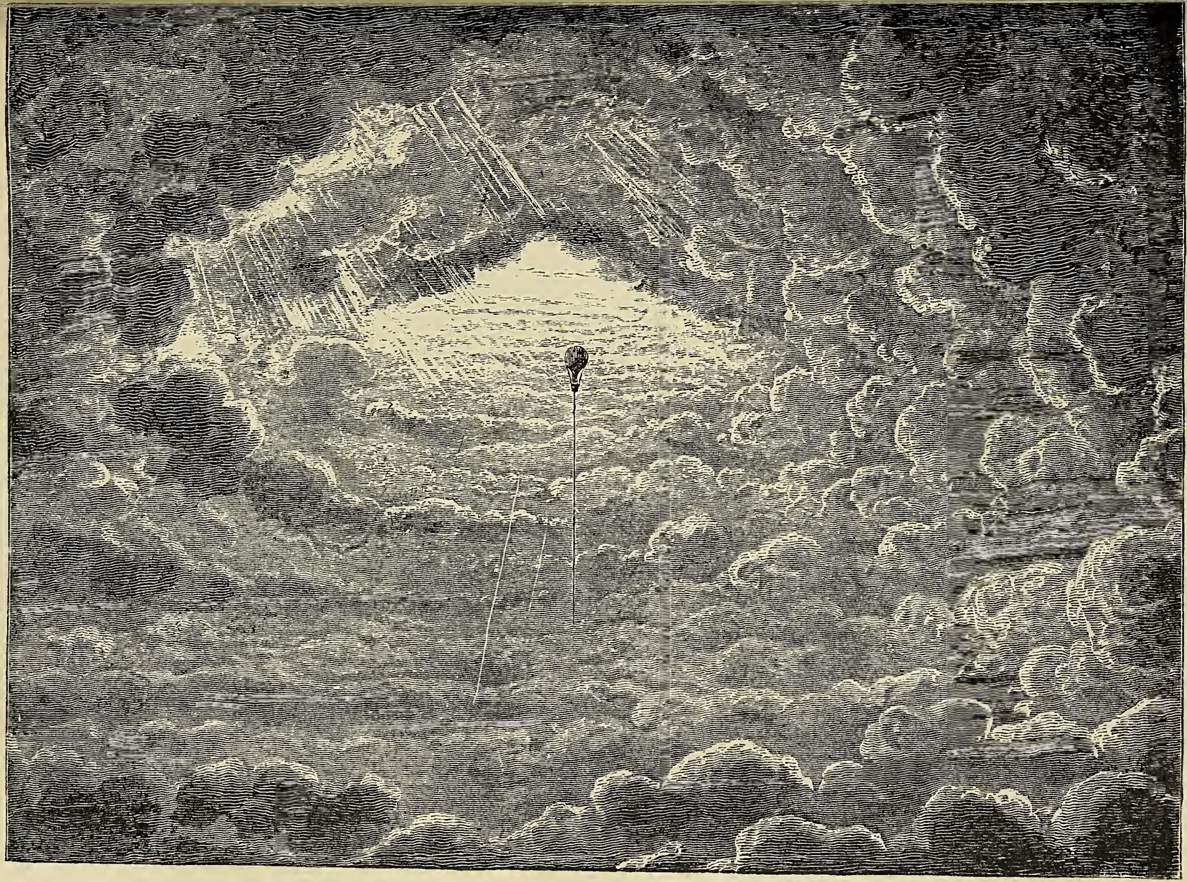
"Below, between the white fleecy clouds—true emblems of God's pure works, brilliant drapery of heaven's vast gallery—all of a sudden I hear the roar of artillery. What is it? Something like distant thunder. Again. It comes from below, one of those peculiar noises that puzzle the discrimination of the aëronaut. Looking over my car, I find myself still over the city of Lafayette. Oh, it is only the distension of a slight fold in the balloon that caused the strange sound!"

Here the test paper showed very slight signs of the presence of ozone, and I smelled it sensibly as I grazed a cloud in coming down to a barometer of twenty-four. After I had descended to the lowermost clouds, I discharged ballast, and rose up till the barometer stood twenty-one. The Wabash now presented the appearance of a crooked thread of water, and "Jupiter" was again stationary in space. Here my log reads thus:

"If I can't make a trip east, I will remain in this gorgeous chamber of heaven. I feel rejoiced—invigorated—extremely happy! God is all around me—'Astra castra, Numen lumen.' The manifestations around me make me rejoice in exclamation and admiration of God's handiwork. Glorious reverie! This feeling is worth a lifetime's laudation of a thousand miles trip."

Such were my cogitations while standing in space; and permit me to say here that most of those thoughts break out into involuntary exclamations. There is a physical cause for this. The animal system expands under diminished atmospheric pressure. With me it never fails to produce exhilaration. The brain becomes active, the blood circulates more rapidly, the organs of the five senses become energetic and more acute, and the mind becomes illuminated, as it were, by something that brings to recollection, with the rapidity of lightning, all the concomitants of the subject passing through it.

I have frequently heretofore determined, when sailing through these



"STANDING LIKE STATELY SENTINELS AROUND THE PORTALS OF HEAVEN."

peculiarly formed cloud-fields, which never fail to produce these exhilarations in me, to publish the full log of exclamations and adorations that they bring forth with an insuppressible spontaneity, but my judgment always forbade me when I got down. After descending to the earth, the feeling of exaltation is ever followed by a languor that acts the other way.

To prevent misunderstanding in this connection, I must be explicit in saying that this occurs more particularly when sailing among and above these vast galleries of nimbi-cumulus clouds. The study of these clouds is worthy the particular attention of the meteorologist. Their habitudes and action, connected with the wonderful power they possess of reflecting heat and their very persistent characteristic of *fixedness*, throws around them a mystery that requires explanation to the progress and perfection of the science of meteorology.

After feasting my eyes for a while again, the following notes were made:

"I don't care where I go; the view is becoming more grand."

Here I rose until the barometer indicated 20.3.

"Flies are buzzing around me. They are sharp, clipper-looking animals, more so than the common house-fly."

Here I noticed that the rattling sound of the railroad trains in motion came in vibrations, like the pulsatory sounds of an æolian harp, and would circulate like the rolling peals of heavy thunder, and with reverberations that resembled thunder so much that I looked all around to see the storm, but there was none.

My note-book reads at this point: "The beautiful pyramidical clouds stand to their places like marble statues, like majestic sentinels around the portals of heaven. I hear a locomotive whistle just now as plain as though it was by my side, and yet I can't discern the vestiges of a train below."

While standing in the midst of these huge piles of clouds, I felt occasionally an agitation of the atmosphere. The flag would flutter, and "Jupiter" would sway back and forth upon its vertical axis. They were slight whirlpools seemingly caused by focal reflection of conjunctive clouds. I could account for it in no other way. Again I quote from my note-book:

"3 o'clock 55 minutes. Just got through one of those aërostatic freaks that put all experience at defiance; after shovelling overboard nearly fifty pounds of sand, the balloon, from a completely-filled distension of a few minutes previous, is now quite flaccid in her lower hemisphere, and is brought to a stand at a barometer of 25.8.

"Shouts of people audible, ozone paper tinged brown, breeze fluttering around me, cow-bells jingling below, wood-chopping plainly heard. My ears begin to ache most violently, and shouts upon shouts proceed from below. Moving slightly west of south. I will descend and see what the people are shouting so for."

Here I came down, sixteen miles below Lafayette, in the midst of

Grand Prairie. The people soon flocked together—men, women and children. I gave them each a slice of bread, and distributed to them newspapers and pamphlets. After resting here about twenty minutes, I put the air-ship in balanced trim, so that it just glided over the top of the prairie grass, and the people all followed it as it slowly drifted along at a common pace, until I tipped out a little sack of sand to make it surmount a fence, and then the upsoaring "Jupiter" caused most wonder-stricken upturned faces. As the air-ship ascended, I waved the American flag, and my prairie audience, of about thirty strong, gave a hearty hurrah.

The balloon had now been emptied to half its capacity, which left remaining about one hundred pounds of sand-ballast, and with this I was determined to feel for the great eastern current above. I made very little headway as the balloon gradually rose. In twenty minutes after I left the prairie the barometer stood at 19. Nothing could surpass the landscape scenery below—a smoothly hollowed plain, interspersed with little patches of woods and full of habitations and meandering creeks and rivers and painfully straight lines of railroad track. It was a fruitful and glorious-looking circle. The clouds soon involved me. Here my log says:

"Great God! what a grand vision of clouds around and below me! What an exalted feeling! Nothing can equal this cloud-scene. Nature is in grand council, and its majestic representatives are massive, dome-shaped clouds, in mantles of snow-white drapery, illuminated intensely with a white-hot sun."

The thermometer stood here at 55°, and yet the reflected rays of the sun would strike me like hot tin. Brilliant bands of thread-like beams were darting through a portion of this vast circular group of clouds toward the earth. The world below was obscured by a gossamer-like mist. There was a profound silence. I could hear distinctly the arterial pulsations of my system. The "Jupiter" appeared to stand still in the midst of this grand, heaven-clad council. The tympans of my ears were flapping from diminished pressure. These clouds appeared to be all setting on a common level, as though they were planted on a great circular rim, a few floating within the open part containing the balloon. Here I discovered that my vision had become keen. I could read the figured verniers of my instruments without eye-glasses.

Having a pamphlet with me (thrown in my car by Dr. Wetherill—"Pouillet Müller's Lehrbach der Physic und Meteorologie") which had on the cover very fine print, and which I could not read with the naked eye on the surface of the earth, I found I could peruse it here without glasses with facility. My ears were for a while just the reverse, but they too became more steady in the course of half an hour. The base of my brain suffered a little pain all the while. It must have been caused by the removal of atmospheric pressure. My eyes would thus become more convex. I can account for it in no other way.

These persistent clouds, standing apparently in a circular form, without motion or alteration, puzzled my comprehension. Neither increase nor diminution accompanied them. Nature had taken a rest over Grand Prairie, and pavilioned it with a garment of the most brilliant costume that reflected and refracted light could invest it with. Behind this great belt of cloud-pyramids there appeared an ashen-colored ring or outer belt seen between the pyramidical pillars, and to the east only there appeared a sheet of inclined stratus clouds. Could the great prairie have anything to do with this? I never saw its like before in so striking and characteristic a form. I have seen the cumuli often in groups, but they were always changing, both in place and shape, as well as in dissolution and composition, but in this, as above stated, the whole mass was stationary.

Above this point there was not the slightest manifestation of ozone. The paper kept its unaltered white color. My nose suffered very much from its membranes becoming parched; and although the atmosphere was cold, being 53° in the shade, and the barometer at 18, there appeared to be something present or absent that produced in my system the phenomenon of fever. My lips were swollen and parched, my flesh was all unwrinkled, smooth and filled out under the skin like a youth's. There appeared to be a stagnation in the atmosphere, and the impression was inevitably forced upon me that nature had an atmospheric circulation necessary to its proper order, as the animal system had of blood necessary to its healthfulness, and that in this instance it had fallen into a comatose condition; nevertheless, I felt intensely happy, somewhat like one under the influence of a dose of nitrous oxide gas. My companions, the flies, were roused up here by my searching for food, having become hungry. They flew in very short, spasmodic flights, buzzing rather loudly, and evidently felt discommoded for the want of atmospheric stability.

I found the "Jupiter" now intensely distended by a warning that always draws the attention of the aëronaut to an observation of his balloon—that is, the network suddenly slipping a little from where it was too taut to where it was loose. The action, at so great a height, where all is silence most profound, caused a noise like distant thunder. Looking down to the earth through the vast chasms of the clouds, I discovered by the aid of my compass that I was sailing due east. Thus the upper eastern current was attained at a barometrical height of 17.6, being nearly three miles' altitude.

Having only about fifty pounds of sand-ballast left, and knowing that this would not suffice for a whole night's sail, as the coolness of the air upon the setting of the sun would alone require nearly all to compensate the condensation of the gas in consequence, I concluded to make a landing. In looking down through the clouds, I noticed a town a little to the east of me. By reference to my chart, it proved to be Crawfordsville. Knowing that if there were no currents below I could easily and safely land in the town, and in order to make the

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arrival more interesting, I concluded to send my letter-mail ahead, and to effect this in a systematic form the following expedient was adopted. Having with me a muslin sheet nine feet square, I attached to each of its corners strings of about five yards in length. These were tied together in a knot at their lower extremities, and to this knot was attached the mail-bag, and then I dropped it overboard. It made an admirable parachute. A few minutes' travel informed me that it would fall a considerable distance to the south of Crawfordsville, as there was a slight breeze below drifting it in that direction. I pulled the valve of "Jupiter" and followed, and soon overtook the mail. We kept near together all the way down, as I could regulate the descent of the balloon to the descent of the parachute, and both the aërial machines landed within fifty yards of each other on the public road six miles south of Crawfordsville, their descents being very slow.

In the preparation of this ascension I was assisted by Dr. Charles Wetherill, the eminent analytical chemist, who was residing in Lafayette.

From this and several former ascensions from the western prairies, I found them to be nurseries of cyclones, out of which those terrific tornadoes are propagated. These great, flat surfaces, bare of forests during the calm period of summer, heat the overhanging air to a degree sufficient to produce strong uprising currents, which, when once put in motion, sweep over the country with increasing momentum as they pass along without forest or hill to break them up, until they acquire a force sufficient to carry buildings from their foundations, and to lift persons and animals high up from the ground.

The great mass of incipient nimbi, as mentioned above, never fails to produce great thunder-storms, and too often very destructive tornadoes.

It is impossible to describe the silent majesty of these scenes, and dull would be the mind of any one that could look upon them without ejaculatory expressions of joy and admiration.

The first ascension I ever made moved me to admiring exclamations; and even now, when sixty-six summers have passed over my head, I still enjoy these exhilarations, and delight in speaking my admiration of God's handiwork as embellished by cloud-land scenery. If these narrations shall have the effect of arousing a spirit of atmospheric investigation, they will well repay the writer for his devotion to an art that is yet to make mankind more refined and happier. Progress is a law of nature; and in nothing is it more desirable to move than in the way of easy and swift transition, and in that to be surrounded by the soul-inspiring scenes that constantly surround the aërial traveller.

## CHAPTER XLVI.

An ascent from Palace Garden, New York—Perilous descent—Connor's fatal ascent.

IN April, 1860, I made an ascent from Palace Garden, New York City, which became more interesting than I had anticipated. The first remarkable feature of the affair occurred when a height of several thousand feet was attained. All of a sudden, as it were, my ears were greeted with the most unearthly noises that could be imagined. It seemed as though all the calathumpian bands of the United States were in grand concert below, assisted by the strongest powers of Pandemonium, interlarded with artillery from a thousand big guns, and garnished with all the shrieks of infernal population, according to the brimstone theory of that place. I must use strong language to convey a faint idea of this horrible discord. I did involuntarily ejaculate, "Is hell beneath me?" and my hair bristled up with astonishment. Why this remarkable hideousness was observable on this occasion, more than any previous one, I cannot divine, unless it was the south-east breeze beneath me, which came freighted with the city clangor between that point and the Battery. As I rose, the din and discord melted gradually into cadences of melodious intonations, and the mind, sympathizing with the sounds, was tuned to sweetest harmony. Such are some of the peculiarities of balloon voyages.

My main object in this trip was to make an effort at local current sailing. It was quite practicable to sail over New Jersey, or up Manhattan Island, or over Long Island. After sailing a few minutes in the south-east breeze, I went northward straight over the length of Randall's Island. There I rose higher, and struck a breeze from the west, and made for Flushing; there I descended, with the intention of landing at Whitestone, on Long Island. The south-east wind was strong at the surface of the earth, but did not extend in height over a thousand feet. In coming down that thousand feet the balloon made three miles in five minutes, and I struck the ground near Bininger's cottage mansion; but the grapnel, striking into a gravel walk, failed to secure a fastening. In the concussion the balloon careened so much as to tilt out of the car a sand-bag. I was on the ground in front

of the cottage long enough to have a man run up to me and clap his hand upon the car; but as soon as the "Ganymede" recovered her perpendicular, she made a bound over the cottage, swinging the grapnel into the eaves of the roof; but the balloon being stronger than the part where the hook took effect, something gave way. The grapnel next took effect in a big tree between the cottage and the sound, but the second squall that struck her sent her reeling on the beach, with the side of the basket, or rather the rim of the wicker-work, cut through by the anchor rope.

Here a very interesting aërostatic experiment occurred. The balloon, being nicely poised in the atmosphere, was kept by the rebound swinging to and fro in mid-air between the water and land. A guy-rope was trailing on the beach, within the reach of a man standing there, with eyes and mouth open with wonderment; but in another moment my car was on the ocean wave. The man cried out in most melancholy tone, "O my God, now you're in the water!" I answered, "Yes, sir, I am ducked; but I'll get over this little sea." I thought to myself, "I preferred the water to the air, for this reason: my grapnel is lost, and now, if I take the air and sail over to Manhattan Island, this strong south-east breeze will dash me into the tall trees and damage the balloon; while if I take to the water and drag the car through it, I shall have time before I reach the other side of Jordan—which was a mile off—to disgorge the gas and render the 'Ganymede' controllable without an anchor." I passed the stern of a ship, but it took no notice of me, and seemed to hurry out of my way. The squalls now and then became so violent as to careen the balloon over until she touched the sea, floundering me into the water up to my shoulders, and putting me through several hydropathic exercises not pleasurable to contemplate. I was afraid the violence of the squalls might collapse the air-bag, but I soon found a remedy for this by hanging part of my weight on the hoop above me, so as to bring the basket more up in the water and allow the aërial craft to make more headway. I was half an hour in going over the sound, about a mile and a half in breadth; and when within a half mile of the beach, a full open valve rendered the "Ganymede" so docile as to enable her to drag me well up on the beach with her water-saturated load. Wet and chilled, I reached the land a little below Throgg's Neck, on the premises of D. L. Lawrence, Esq., whose kindly comforts I shall ever remember with gratitude. Messrs. Charles Freeman and Walter Cheatham followed me with a row-boat, ready to pick me up, if the emergency of a total "shipwreck" had rendered it necessary. Mr. Van Schaick also placed me under obligations in assisting me to reef the "Ganymede."

Another reason for my preference for the sea bath was this: by this mode I could rescue the balloon in good order; but had I trusted to the land and woods, she might have been wrecked, as was the ill-fated "Atlantic" last year.

Taking it all in all, the trip was more instructive and entertaining

than I had calculated, and it taught me some things practically that before I had only known by theory.

On the 10th of the following May a young man named Connor, to whom I had given some instructions, undertook to make an ascent from Palace Garden. As I was not a witness of the affair, I prefer to take an account of it from one of the newspapers:

"The inflation of the balloon—the 'Venus'—progressed successfully until one of the strips of oiled muslin of which it was made gave way. Mr. Connor sewed it up as he best could, remarking in reply to interrogatories, that the rent might give way, but that he would not give up the ascension for any such trifle as that. As the balloon filled, the wind, which was blowing in violent gusts, swayed it from side to side with such force that it was all four or five men could do to keep it in its place. Several attempted to dissuade Mr. Connor from the ascension, but he persisted in undertaking it, and when everything was in readiness stepped into the wicker-basket, and shaking hands with his wife, gave the word to 'let go.' Before the balloon had risen high enough to clear the building, a violent gust of wind caught it and dashed it with great violence against the concert- and dancing-saloon. The basket containing Mr. Connor was hurled through one of the windows which look out from this room upon the garden, but unfortunately the anchorage which the balloon thus suddenly found proved only temporary, and the top of the basket, in which the unfortunate aëronaut still remained, next caught underneath the edge of the street roof, peeling it off as if it were pasteboard. Then it was dashed with great violence against a sky-light, and instantly the balloon collapsed.

"The crowd inside the garden could not see where the balloon had gone. It was supposed it had been landed in one of the adjacent yards. There was intense excitement. Mrs. Connor fainted, the women screamed, and the men rushed frantically for the street to learn the fate of Mr. Connor. No one expected to find him alive. People outside hurried through the basements of the adjoining dwellings into the rear yards.

"The body of the balloon went into the adjacent yard; the basket containing Mr. Connor remained on the roof of the concert-saloon. He was taken out insensible and conveyed into a room over the barroom attached to the garden, where several physicians at once attended him. On the face, breast and back of his head were several slight cuts. No bones were broken. His injuries proved to be chiefly internal. He remained in an unconscious state until 11 o'clock P. M., when he expired."

Concerning this fatal result of Connor's recklessness I addressed the following letter to the Herald:

"Having received several letters from outside parties inquiring for some facts connected with the cause of Mr. Connor's death in his attempted ascension with the balloon 'Venus' from Palace Garden on the 10th of May, permit me to meet them in a few words in your paper.

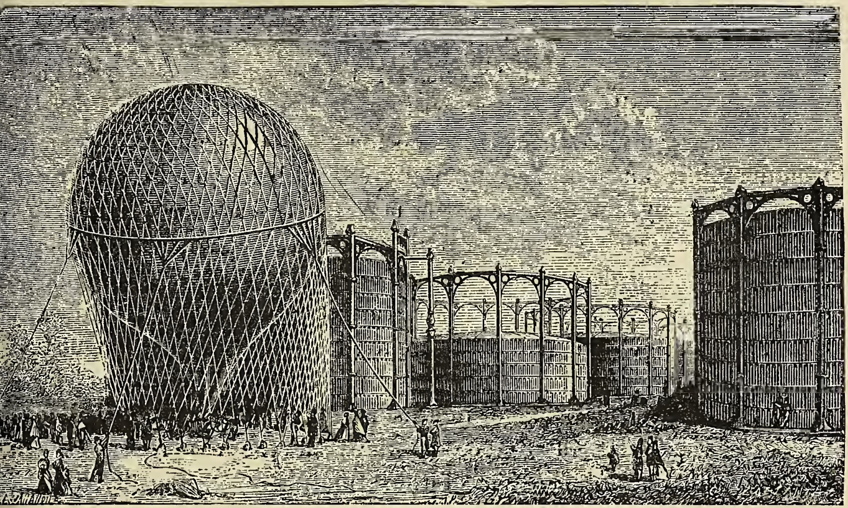
The substance of the matter is embraced in this: He chose to take bad advice from a pretender to science, and from that advice discarded my instructions, and discarded even the principal part of the balloon rigging which I furnished him. I supplied him with a net of extraordinary strength, because the balloon was a strong one; but in the very face of this he got up a temporary net-work, much too small for his balloon, and this he rigged in a manner that would afford him no protection in the event of the balloon coming in contact with solid obstacles. I was much surprised at Mr. Connor's deviation from my preparations and his departure from my plain instructions. This leads me to the conclusion that Mr. Connor's mind must have been anything but composed when he attempted the trip. He cried out for more ballast when he should have busied himself in throwing overboard half of what he had. Indeed, he was quite unstrung in mind and body, as your report of the affair says of his nervous system. His death seems to have been more the result of that condition of his nervous system than of the concussions and bruises he encountered.

"The 'New York Tribune's' report stated, upon hearsay, that Mr. Connor had a lawsuit with me about the balloon, and that he and I parted that same day in the court-room. There is not a word of truth in that. I was not within 150 miles of New York at the time, nor had we ever an unkindly word, and I was much surprised to see such a report in so respectable a paper, and that report upon hearsay.

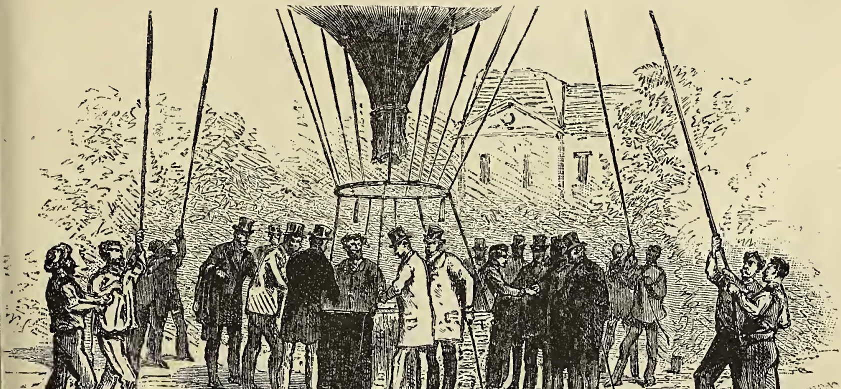
"It was not the intrinsic danger of ballooning that caused the accident. With a proper judgment, founded on a scientific knowledge of the nature of the art and the elements with which it is surrounded, the ascension would no doubt have gone off very successfully, though the day was of such a tempestuous character that a prudent novice should not have attempted to dare its squalls. Courage alone will not make a successful balloonist. Prudence and foresight and the closest study of atmospheric phenomena, coupled with a knowledge of mechanical powers, are the only true safeguard in the art, when it is attempted to be practiced in the face of surrounding dangers.

"JOHN WISE.

"LANCASTER, PA., May 16, 1860."



INFLATION OF A LARGE BALLOON.



AERONAUTS STARTING.

## CHAPTER XLVII.

Voyage of Messrs. Haddock and Lamountane—300 miles in four hours—Descent of the balloon in the Canada wilderness—Abandonment of the balloon—The aëronauts four days without food.

ON the 22d of September, 1859, Mr. John A. Haddock and Mr. John Lamountane made an ascension from Watertown, New York, and drifted into the Canada wilderness, where they were compelled to abandon their balloon and to wander for four days without food. The following is Mr. Haddock's account of this adventure:

"Nearly every one is aware that the second ascension of the 'Atlantic' was advertised for the 20th of September. The storm of that and the following day obliged the postponement of the ascension until the 22d. Every arrangement had been made for a successful *inflation*, and at twenty-seven minutes before six P. M. the glad words 'all aboard' were heard from Mr. Lamountane, and myself and that distinguished aëronaut stepped into the car. Many were the friendly hands we shook, many a fervent 'God bless you' and 'Happy voyage' was uttered, and many handkerchiefs waved their mute adieu. Just as I stepped in my good friend Fayel stripped off his overcoat and pressed it upon me, saying that, as Mr. Lamountane had no outer garment, we would need more than we had. I took it, and it did me good service, but I was never able to return it. Mr. Burnett, of the American, in the kindest manner supplied us with some eatables and drinkables. 'Let go all,' and away we soared; the horses on the square 'reared and pitched' a good deal at the novel sight, but in an instant all minor sounds of earth had ceased, and we were lifted into a silent sphere whose shores were without an echo, their silence equalled only by that of the grave. Not the least feeling of trepidation was experienced; an extraordinary elation took possession of my soul, and fear was as far removed as though I had been sitting in my own room at home.

"Two or three things struck me in looking down from an altitude of half a mile—the small appearance of our village from such a height, and the beautiful mechanical look which the straight fences and oblong-square fields of the farmers present. The buildings in the village do not, from such a height, appear to cover a tenth part of the ground.

The poor old court-house looked like a pepper-box standing on a ten-acre lot, and the first church spire barely equalled in size a respectable May-pole.

"As we rose into the light fleecy clouds, they looked between us and the earth like patches of snow we see lying upon the landscape in spring-time; but when we rose a little higher, the clouds completely shut out the earth, and the cold white masses below us had precisely the same look that a mountainous snow-covered country has as you look down upon it from a higher mountain. Those who have crossed the Alps by the Simplon Pass, or have stood upon one of the lofty summits of the Sierra Nevada, and gazed down upon the eternal snows below and around them, will be able to catch the idea I am trying to convey. In six minutes we were far above all the clouds, and the sun and we were face to face. We saw the time after that when his face looked very fair to us. In eight minutes after leaving the earth, the thermometer kindly loaned us by T. H. Camp & Co. showed a fall of 24 degrees. It stood at 84 when we left. The balloon rotated a good deal, showing that she was ascending with great rapidity. At 5.48 thermometer stood at 42, and falling very fast. At 5.50 we were at least two miles high; thermometer 34. At this point a suggestion made just before starting, by Judge Clarke, of Plessis, was found to be a very good one. He had advised the taking along of some cotton, with which to fill the ears when at great heights, and my father had procured me some. The unpleasant ringing sensation had now become painful, and I filled both ears with cotton. This made my head feel a good deal as a very large hollow pumpkin may be supposed to with a humming bird buzzing upon its surface—a comparison with which, doubtless, many who read this account will hardly quarrel. At 5.52 we put on our gloves and shawls, an extra pair for Mr. Lamountane being found in friend Fayel's overcoat; thermometer 32. The wet sand-bags now became stiff with cold; they were frozen. Ascending very rapidly. At 5.54 thermometer 28, and falling. Here we caught our last sight of the earth by daylight. I recognized the St. Lawrence to the south-west of us, which showed we were drifting nearly north. At six o'clock we thought we were descending a little, and Mr. Lamountane directed me to throw out about twenty pounds of ballast. This shot us up again; thermometer 26, and falling very slowly. At 6.05 thermometer 22; my feet were very cold. The 'Atlantic' was now full, and presented a most splendid sight. The gas began to discharge itself at the mouth, and its abominable smell, as it came down upon us, made me sick. I had been trying some of friend Burnett's 'sinews of war,' but everything that would come up left my poor stomach in a flood. A moment's vomiting made me feel all right again. Lamountane was suffering a good deal with cold. I passed my thick shawl around his shoulders, and put the blanket over our knees and feet. At 6.10 thermometer 18. We drifted along until the sun left us, and in a short time thereafter the balloon began to

descend. At 6.30 thermometer 22—rising. Threw over about five pounds of ballast. We must have been, before we began to descend from this height, three and a half miles high. At 6.32 thermometer 23—rising. We were now about stationary, and thought we were sailing north of east. We could, we thought, distinguish water below us, but unable to recognize it. At 6.38 we threw over a bag of sand, making eighty pounds of ballast discharged, leaving about one hundred and twenty pounds on hand. We distinctly heard a dog bark. Thermometer 28—rising rapidly. 6.45 thermometer 33.

"At 6.50 it was dark, and I could take no more memoranda. I put up my note-book, pencil and watch, and settled down into the basket, as much at home as though at my post in the *Reformer* office. From this point until the next morning I can only give my experiences from memory. The figures in the preceding narrative were all made at the time, and the variations of the thermometer can be depended upon as accurate.

"We heard, soon after dark, a locomotive whistle, and occasionally could hear wagons rumbling along the ground or over a bridge, while the dogs kept up an almost ceaseless serenade, as if conscious there was something in the sky monstrous and unusual. We sailed along contented and chatty until about half-past seven, when we distinctly saw lights and heard the roaring of a mighty waterfall. We descended into a valley near a very high mountain; but as the place appeared rather forbidding, we concluded to go up again. Over with thirty pounds of ballast, and skyward we sailed. In about twenty minutes we again descended, but this time no friendly light or 'deep-mouthed watch-dog's heavy bay' greeted us. We were over a dense wilderness, and settled down over a small lake. We had our life-preservers ready for use, but got up again by throwing over all our ballast except about eighteen pounds. Mr. L. now said it was folly and madness to stay up any longer, that we were over a great wilderness and the sooner we descended, the better. We concluded to settle down by the side of a tree, tie up and wait until morning. In a moment we were near the earth, and as we fell I grasped the extreme top of a tall spruce, which stopped her descent, and we were soon fastened to it by the large drag-rope. The touch of that spruce sent a thrill of discomfort to my heart, for I knew that its kind did not grow in any well-settled nor any warm country.

"Mr. Lamountane said, after he looked around and made as much of an examination of the scenery as he could do for the darkness and rain (for it had rained the past hour), that the 'Atlantic' was played out —we were far into the woods, and if we got out alive we ought to be thankful.

"We rolled ourselves up in our blankets and patiently waited until morning. The rain dripped down upon us in rivulets from the great balloon, and it was not long before we were wet as could be. After a night passed in great discomfort, we were glad to see the first faint ray

of daylight. Cold and wet and rainy the morning broke, the typical precursor, we were to learn, of many other mornings to be spent in those uninhabited wilds. We waited until six o'clock, in hopes the rain would cease, and that the rays of the sun, by warming the gas in the balloon, would give us ascending power sufficient to get up again for the purpose, if no other, of obtaining a view of the country into which we had descended. The rain did not cease, and we concluded to throw over all we had in the balloon except a coat apiece, the life-preservers, the anchor and the compass. Overboard, then, they went —good shawls and blankets, Mr. Fayel's overcoat, bottles of ale and a flask of cordial, ropes and traps of all kinds. The 'Atlantic,' relieved of her wet load, rose majestically with us, and we were able to behold the country below. It was an unbroken wilderness of lakes and spruce, and we felt, then, that we had gone too far, through a miscalculation of the velocity of the balloon. As the current was driving us still to the north, we dare not stay up, as we were drifting farther and still farther to that 'frozen tide' from which we knew there could be no escape. Mr. L. seized the valve-cord and discharged gas, and we descended in safety by the side of a tall spruce. We made the 'Atlantic' fast by her anchor, and for a moment talked over what we should do. We had not a mouthful to eat, no protection at night from the damp ground, were distant we knew not how far from habitation, were hungry to start with, no earthly hope of raising a fire, and no distinct idea as to where we were. We concluded to trust to the compass kindly loaned by H. K. Newcomb, Esq., and take a course which would bring us out of any wilderness we might be in. We settled in our own minds that we were either in John Brown's tract or in the great Canada wilderness, to the south, we thought, of the Ottawa, and knew that a course south by east would take us out if we had strength enough to travel the distance. Mr. L. stepped up to the balloon and gave the edge of the basket a parting shake, saying, 'Good-bye, old "Atlantic,"' and I fancied I could see a tear in his honest eye when he said it. He seemed greatly to regret his inability to perform his engagements at the Kingston and New York State Fairs, at both of which he was advertised to make ascensions.

" To the south-east, then, we started. After travelling about a mile and a half, we came to the bank of a small creek flowing down from the westward. At this point we were agreeably surprised to find that some human being had been there before us, for we found several small trees cut down, the coals from an old fire, and a half barrel which had contained pork. I eagerly examined the stamp. It read,

'Mess Pork.
'P. M.
'Montreal.'

This settled the question that we were in Canada, for I very well knew that no Montreal inspection of pork ever found its way into the interior of New York State. We travelled all day Friday up the unknown

creek, which kept its general course to the south of west, crossing it about noon on a floating log, and striking on its southern bank a 'blazed' track, which led us up to a deserted timber road, lying on the opposite side from a large lumbering shanty. We hoped one of the lumber roads might take us out to a settlement; but after travelling up them all until they terminated in the wilderness, we concluded to cross the creek to the shanty, and stay in it all night. Lamountane got across safely. But my weight was greater than his, and the raft let me into the stream. I sank in all over, and swam out, though it required all my strength to do so, and on reaching the bank I found myself so chilled as scarcely to be able to stand. I took off my clothes, wrung them, and we proceeded to the shanty, where we found plenty of refuse straw, but it was dry, and under a pile of it we crawled, pulling it over our heads and faces in the hope that our breath might aid in warming our chilled bodies. I think the most revengeful, stony heart would have pitied our condition then. The weary hours of night at last wore away, and we held a new council. It was evident, we reasoned, that the creek we were upon was used for 'driving' logs in the spring season. If, then, we followed it to its confluence with the Ottawa or some stream which emptied into the Ottawa, we would in time get out the same way the timber went out. The roof of the shanty was covered with the halves of logs, scooped out in a manner familiar to all woodmen. These were light and dry, and would form an excellent raft. Why not, then, take four of these, tie them to cross-pieces by withes and such old things as we could find around the shanty and pole the structure down to that civilization which a saw log ought to be able to reach? Such was the course we adopted. We dragged the logs down to the creek, and Lamountane tied them together, as he was evidently more of a sailor than myself. We got under way, and as we pushed off a crow set up a dismal cawing—an inauspicious sign, and ominous of the great trials and sufferings in store for us. We poled down stream about ten miles, and came abruptly upon an immense pine tree which had fallen across the stream, completely blocking the passage of the raft. No other alternative was left but to untie the pieces and attempt to push them through under the log. This was at last done; tied the raft together again, and poled her down stream. To-day we ate each a raw frog, all we could find, and began to feel that we were *hungry*. But there was no complaining; our talk was of the hopeful future, and the civilization we hoped yet to reach. Down the creek we went into a lake some two miles long, and into which we of course supposed the stream passed, having its outlet at the lower end. We followed down the northern bank, keeping always in shallow spots, so that our poles could touch the bottom, until we arrived at the bottom of the lake, where we found no outlet, and turned back upon the southern bank in quest of it. On reaching the head of the lake we found that the current of the creek turned abruptly to the right, which was the reason of our losing it.

"We felt happy to have found it again, and plied our poles like heroes. We passed, during the day, the spot where we had first struck the creek, and where we had made a sightly landmark which might afterward aid us in finding the 'Atlantic,' should we ever wish to do so in order to get her out. At night we did not stop, but kept the raft going down through the shades of awful forests, whose solemn stillness seemed to hold the unrevealed mystery of our darkening future. About ten o'clock it began to rain again. We stopped the 'vessel' and crawled in under some 'tag' alders on the bank, where our extreme weariness enabled us to get, perhaps, half an hour's sleep. Rising again (for it was easier to pole at night in the rain down an unknown stream than to lie on the ground and freeze), we pressed on for a couple of hours, until about three o'clock, when pure exhaustion induced us to stop again. This time we found a spot where the clayey bank lacked a little of coming down to the water. On the mud we threw our little bundle of straw, and sat down with our feet drawn up under us, so that our bent bodies presented as little surface as possible for the rain to beat upon. But we could not stand such an uncomfortable position long; and as the daylight of the Sabbath broke upon us, we were poling down the stream in a drizzling rain. At eight o'clock we came to a place where the stream canoned, rushing over a stony bed, down a steep descent between high rocks on either bank. To get our raft down this place we regarded as hopeless. We tied up and examined the shore. Here, again, we found unmistakable evidence of lumbermen, as they had evidently camped at this point, to be facilitated in the attempts they were doubtless obliged to make to get the timber down the canon. The rapids were about a third of a mile long, and in all the rapids of Black River there is nothing so wild and romantic as these. We descended the bank, and thought it best to try our luck on foot. After travelling about a mile, we found the bank so tangled and rugged, and ourselves so much exhausted, that locomotion was impossible. So we concluded to go back, and if we could get the raft down a piece at a time, we would go on with her; if not, we would build as good a place as possible to crawl into and prepare for death.

"We went back, and after examining the stream attentively concluded to try to get the raft down. We at once commenced, and I freely confess this the most trying and laborious work of a life of labor. The pieces would not float over a rod at a time before they would stick on some stone which the low water left above the surface, and then you must pry it over in some way, and pass it along to the next obstruction. We were obliged to get into the stream often up to the middle, and there I several times fell headlong, completely using up our compass, which now frantically pointed in any direction its addled head thought desirable. The water had unglued the case, and it was ruined. After long hours of such labor, we got the raft down, and Lamountane again tied it together. Passing on, in about an hour we

came to a large lake, ten miles long and six miles broad. Around it we must, of course, pass until we should find the outlet. So we turned up to the right, and pressed on with as much resolution as could be expected. To-day we found one clam, which I insisted Lamountane should eat, as he was weaker than myself, and had eaten little or nothing on the day we went up. Around we went, into all the indentations of the shore, keeping always in shallow water. At last we stopped at a place we thought least exposed to the wind. We laid down upon the cold ground, having lifted up the end of our raft, so that the wind might not drift it away in the night. We were cold when we laid down, and both of us trembled by the hour like men suffering from a severe attack of the ague. The wind had risen just at night, and the dismal surging of the waves upon the shore formed, I thought, a fitting lullaby to slumbers so disturbed and dismal as ours. By this time our clothes were nearly torn off. My pantaloons were slit up both legs, and the waistbands nearly torn off. My boots both leaked, and our mighty wrestlings in the canon had torn the skin from ankles and hands; Lamountane's hat was gone the first day out; he had thrown away his woollen drawers and stockings the first day of our tramping, as they dragged him down by the weight of water they absorbed. We slept but little. It really seemed as though, during that night, we passed through the horrors of a dozen deaths. At daylight we got up by degrees—first on one knee and then on the other—so stiff and weak that we could hardly stand.

"Again upon the almost endless lake we went, following round its shore for an outlet. About 10 o'clock we found a broad, northern stream, which we thought was the outlet we were seeking, and we entered it with great joy, believing it would take us to our long-sought Ottawa. Shortly after entering the stream it widened out and assumed the form of a lake. We poled up the westerly shore for about seven miles, but found we were again deceived. On our way up Lamountane sang these pretty lines:

'Cheer up your hearts, my men,
Let nothing fright you;
Be of a gallant mind—
Let that delight you.'

"His voice was hardly above a whisper, but the song was a source of great comfort to me. His, indeed, was a 'gallant mind,' which the extraordinary hardships and dangers of our position had not daunted. But when we found that all the weary miles of our morning travel had been in vain, and had to be retraced, my resolution certainly failed me for a moment, and I sat down upon my end of the raft and felt like shedding one tear of genuine regret. Yet we felt that our duty as Christian men was to press on as long as we could stand, and leave the issue with God.

"It had now been four full days since we ate a meal. All we had

eaten in the mean time was a frog apiece, four clams and a few wild berries, whose acid properties and bitter taste had probably done us more harm than good. Our strength was beginning to fail very fast, and our systems were evidently about to undergo an extraordinary change. I did not permit myself to think of food; the thought of a well-covered table would have been too much. I thought over all of poor Strain's sufferings on the Isthmus of Darien, where he, too, was paddling a raft down an unknown stream, but never believed we could stand half the amount of suffering he did. Besides, he had means to make a fire; we had none.

"He was upon a stream which he knew would lead to the sea and safety; we were upon waters whose flow we knew really nothing of, and were as much lost as though in the Mountains of the Moon. But we 'could not give it up so,' and took fresh courage as troubles appeared to thicken.

"Well, we turned the raft around and poled her back toward the place where we had entered this last lake. We had gone about a mile when we heard the sound of a gun, quickly followed by a second report. No sound was ever so sweet to me as that. We hallooed as loud as we could a good many times, but could get no response. We kept our poles going, and had gone about half a mile, when I called Lamountane's attention to what I thought was a smoke curling up among the trees on the side of a hill. My own eyesight had begun to fail me to such an extent that I could not depend upon it when a long, steady gaze was necessary. He said it was smoke, and that he thought just below it on the bank was a bark canoe. In a few moments the blue smoke rolled gently yet unmistakably above the tree-tops, and we felt that we were saved. Such a revulsion of feeling was almost too much for us. We could hardly believe our senses, and credited anything favorable to our condition with the utmost caution. Our bitter disappointments had taught us that lesson.

"We paddled the raft with the ends of our poles directly across the lake, probably about three-fourths of a mile wide, and made for the canoe. It proved to be a large one, and evidently an Indian's. Up the bank I pressed, leaving Lamountane at the canoe to cut off a retreat by the Indian in case he was timid and wished to avoid us. I came at once upon the shanties of a lumbering wood, and from the chimney of the farthest building a broad volume of smoke was rising. I hallooed; a noise was heard inside, and a noble-looking Indian came to the door. '*Vous parley Français?*' was my eager inquiry as I grasped his outstretched hand. 'Yes, sir, and English, too.' He drew me into the cabin, and there was the head of the party, a noble-hearted Scotchman named Angus Cameron. I immediately told my story, that we came in with a balloon, were lost, and had been four days without food, asking where we were. Imagine my surprise when he said we were *one hundred and fifty miles due north of Ottawa*, in the dense uninhabited forest whose only limit was the Arctic circle. In a word,

we were nearly 300 miles in a due north course from Watertown, in latitude 47.

"Dinner was all ready. The party consisted of four persons—Mr. Cameron and his assistant, who was also named Cameron, Lamab MacDougal (a half-breed) and his son Beauceil. I despatched the young Indian for Lamountane, who came in after a moment, the absolute picture of wretchedness. All that the cabin contained was freely tendered us, *and we began to eat.* Language is inadequate to express our sensations while doing so. The clouds had all lifted from our sombre future, and the 'silver lining' shone all the brighter for the deep darkness through which we had passed.

"Here let me state that the stream we came down so far with our raft is called Filliman's Creek; the large lake we sailed around is called Bosketong Lake, and drains into Bosketong River, which flows into the Gatineau. The Gatineau joins the Ottawa opposite Ottawa city. Mr. Cameron assured us that these streams are so tortuous and in many places so rapid that no set of men could get a raft down, no matter how well they knew the country, nor how much provisions they might have. He regarded our deliverance as purely providential, and many times remarked that we would certainly have perished but for seeing his smoke.

"Mr. Cameron was hunting timber for his employers (Gilmore & Co., of Ottawa), and was to start in two days for down the Gatineau to his headquarters at Desert. If we would stay until he started, we were welcome, he said, to food and accommodations, and he would take us down to Desert in his canoe, and at that point we could get Indians to take us farther on. He also said that he had intended to look for timber on Filliman's Creek, near where the balloon would be found, as near as we could describe the locality to him, and would try to look it up and make the attempt to get it to Ottawa. This would be a long and tedious operation, as the *portages* are very numerous between the creek and Desert—something over twenty, one of them three miles long. Over these *portages*, of course, the silk must be carried on the back of Indians.

"After finishing up his business in the vicinity where we found him, on Friday morning Mr. Cameron started on his return. We stopped on our way up the creek at the place we had erected our signal by which to find the balloon. We struck back for the place, and in about twenty minutes found her impaled on the top of four smallish spruce trees, torn very much. Lamountane concluded to abandon her. He took the valve as a memento, and I cut out the letters 'TIC,' which had formed part of her name, and brought them home with me. We reached what is known as the 'New Farm' Friday night, and there ended our sleeping on the ground—an operation always unpleasant, but particularly so in the fall of the year. Saturday we reached Desert through a drenching rain, from which there was no protection.

"At Desert we were a good deal troubled to obtain Indians to take

us out. At last we appealed to Mr. John Backus, a kind-hearted American trader, who agreed to procure us a complement of redskins sufficient to take us to Beau's place (sixty miles), when it was thought we might obtain horses. Sunday morning we started from Desert and reached Alexis le Beau's about six P. M. The scenery upon this part of our route was sublime and imposing. The primeval forest stood as grand and silent as when created. The Indians we had in our employ to-day surpassed anything I ever beheld in physical vigor and endurance. There were fifteen *portages* to be made during the day's run of sixty miles. They would seize the canoe, jerk it upon their shoulders with a swing, and start upon a dog-trot as unconcernedly as though bearing no burden. Arriving at the bottom of the fall, they would toss the canoe into the stream, cry out, '*Arretes, la!*' and away we would go again, gliding down the stream like an arrow. We travelled fifteen miles and made seven *portages* in one hour and forty minutes.

"At Alexis le Beau's we first beheld a horse and vehicle which they called a 'buckboard,' simply a couple of boards reaching from one bolster to the other, upon which the seats were placed. Starting at seven in the evening, we travelled nearly all night through the forests, over one of the worst roads that ever was left unfinished, and reached Brooks' farm, a sort of frontier tavern, in the early morning, where we slept a couple of hours, and after breakfast pressed on by the stage to Ottawa, which we reached at five o'clock on Monday afternoon. Our first rush was to the telegraph office, whence the trembling wires sped the glad news of our safety to 'loved ones at home.' At Ottawa we were most hospitably entertained. To Robert Bell, Esq., editor of the *Citizen*, and president of the Ottawa and Prescott Railway, as well as Joseph Aumond, Esq., we are under especial obligations by acts of kindness which will not soon be forgotten. Indeed, from the time we left the Bosketong until we reached home we met with nothing but one continual stream of congratulation and proffered kindnesses.

"At Ogdensburg and all along the line of the Potsdam and Watertown R. R., we found large crowds awaiting our arrival, which gave unmistakable evidence of the deep sympathy felt in our fate.

"Several general conclusions and remarks shall terminate this narrative, already too long. 'Why did you permit yourselves to go so far?' will naturally be asked. To which we can only reply that the wind was exceedingly light when we ascended, that we were very soon among the clouds, and consequently unable to take cognizance of our course, or to judge how fast we were travelling. Perhaps it is well here to remark that when you are sailing in a balloon you are utterly unconscious of motion unless you can see the earth. Nor can you tell by a compass in which direction you are travelling, unless you are sufficient of an astronomer to judge from the shifting angles formed by certain stars. In a word, if you cannot see the earth you cannot tell how fast, nor in which direction, you move. This will, perhaps, ex-

plain why we unconsciously drifted off to latitudes so remote. When we rose above the thick masses of clouds before sundown, we undoubtedly struck a rapid current which carried us north-east. It is my opinion that after we had travelled in this current about one hour we struck another current, from a variation of our altitude, which bore us off to the north-west. When we descended near the earth the first time, we ought to have come down. But we were unwilling to land at night in a deep wood, even though we knew we were not far from habitations, and we thought it best to pick out a better place. This was our error, and it came very near being a fatal one to us—it certainly was so to the 'Atlantic.' In trying to find our 'better place' to land, we were unconsciously up longer than we supposed; and as we were travelling in a current which swept us off to the northward at the rate of one hundred miles an hour, we soon reached a country not pleasant or profitable to land a balloon in.

"The loss to Mr. Lamountane by the calamity which has overtaken him does not stop with the loss of his balloon. He had several profitable engagements to fill, which must, of course, all go over, entailing disappointment upon the public and loss upon himself. In his present position, in poor health and not 'overly' rich, I cannot but hope some capitalist will furnish him with sufficient means to carry on his undertakings. Of course the present mishap has not changed his views relative to ballooning, nor has it mine. Mr. Lamountane is a brave man; he probably does not know what personal fear is. Such traits will always command the respect of those who know that the fine temper of steel is only imparted after exposure to severe tests before whose intensity meaner metals perish or sink into blackened and worthless dross.

"JOHN A. HADDOCK."

## CHAPTER XLVIII.

Balloon service in the war of the rebellion—Early experiments for reconnoitring purposes—Necessity for having trained aëronauts—Delusive appearance of things on the earth when viewed from above—General Fitz-John Porter's aërial adventure.

WHEN the war of the rebellion broke out, General Cameron, Secretary of War, wanted me to make a trial of the balloon as a means of reconnoissance. On arriving at Washington I found it impossible to see the secretary, but the matter was referred to General Scott. He in turn referred me to the bureau of topographical engineers. Upon the announcement that a battle was to come off at Centreville (Bull Run) on the 19th of July, I received an order to inflate the balloon from the Washington gas-works, and when filled to proceed with it to Centreville, some twenty-five miles off, and report to Captain Whipple. With an escort of twenty-two men from Small's regiment and an army-wagon, under the order of Major Myers, we left Washington an hour after midnight on the morning of the battle. The progress of towing the balloon over canal, telegraph-wires, through woods and over creeks made it a tedious business, and by noon of the day of the battle we had not got halfway. Upon the rattling of infantry and thundering of artillery greeting our train, it created so much excitement and animation in our command as to hurry onward the balloon, and it was tied fast to the army-wagon and the mules put on the trot. The balloon swaying to and fro as it was hurled along brought it heavily against the branches of a tree, which so damaged it as to render it useless by the time we should reach the headquarters of General McDowell. Major Myers ordered the balloon back to Washington to be repaired and refilled, and brought up as soon as possible to the field of action, believing that the battle would last two or three days. It is needless to say that the battle ended in less than three hours after that time. My experience in that affair confirmed me that balloons are useful as a means of observation in time of battle, when properly managed and used by persons who are competent to form a correct judgment of the ground that can be overlooked. The Wednesday following the battle, I observed from the balloon how the Confederates were approaching the capital, and saw very distinctly

several pieces of artillery poised upon the White House within the distance of five miles. Seeing that it required an easy way of inflating the balloon in order to render it useful, I was permitted by the chief of the Topographical Bureau, Major Bache, to write to Morris & Co., of Philadelphia, for an estimate of cost of a locomotive inflating apparatus with which to decompose steam, so that a balloon could be filled in a few hours at any place where wood could be secured, and had the plan referred to John C. Cresson, a gentleman well versed in such matters. He approved of the plan, and Morris & Co. gave in an estimate of about seven thousand dollars. The appropriation for the Topographical Bureau being limited, the reason assigned for the abandonment of the plan was that "it cost too much." Soon after that I left Washington, and what was done by the balloon service is a matter of history. It did some good service, but, it is safe to say, nothing like what it was capable of doing if it had been properly conducted.

Aëronauts, to be useful for reconnoissance in the time of war, should be trained for the purpose, just as are the military engineers of other departments. Going up with a balloon for the first time is rather bewildering. One cannot fairly realize the situation. Things look very different from what they appear while on the earth. I had a lady up with me on one occasion, and while I was intently noting the vibrations of a mill-dam, I heard her say, "Somebody has empted out a bag of potatoes in the street down there, and they are rolling about." On looking for this singular affair, I found she was looking at a flock of sheep that were on the turnpike beneath us, and they were running around in confusion. The appearance was singularly truthful to the remark. I have myself been deceived as to the true nature of things below. In an ascension I made from the city of Bangor, in the State of Maine, the particulars of which are given in a previous chapter, I was driven north-eastward about twenty miles. When I started, I knew the balloon was moving toward a desolate country. Looking down to the earth, I was struck with the beautiful appearance of a series of what I supposed to be prairies; but upon descending, these enchanting fields turned out to be the roughest kind of juniper bogs, and the delusion cost me my balloon. When the first Napoleon determined to make use of the art as a means of warfare, he established a training school where pupils were daily drilled in the practice of aëronautics, and so it must be always in order to get any valuable service from the balloon as an instrument for reconnoissance.

It is to be hoped, however, that by the time the balloon is made capable of doing mankind essential service, the idea of war shall be banished from the mind of civilized man as a thing too barbarous and brutal to be worked up into tales of glory and honor, to say nothing of moral excellence.

In connection with this subject, the following account of an aërial adventure of General Fitz-John Porter, on the 16th of April, 1862, before Yorktown, as given in one of the newspapers, will be of interest:

"The exciting event of the day has been a balloon reconnoissance by General Fitz-John Porter on a scale of rather greater magnitude than was intended. At five o'clock in the morning Gen. Porter took his place in Prof. Lowe's balloon. He supposed the usual number of ropes were attached to it, whereas there was only one, and a portion of this, as we afterward ascertained, had been burned by vitriol used in generating gas. Taking his seat in the car, unaccompanied by any one, the rope was let out to nearly its full length—the length is about nine hundred yards—when suddenly snap went the cord and up went the balloon. This was an unexpected part of the programme. The men below looked up with astonishment, and the General looked down with equal bewilderment.

"'Open the valve,' shouted one of the men below.

"'I'll manage it,' responded the General.

"Up went the balloon, higher, higher. It rose with great rapidity; its huge form lessened as it wildly mounted into the regions of the upper air: it became a speck in the sky. The wind was taking it in the direction of the enemy's territory. By this time every staff officer and hundreds of others were looking at the moving speck. It is impossible to describe the anxiety felt and expressed for the fate of him, the central object of thought in that far away moving speck, every moment becoming less visible. It is seen to move in our direction; the countenances of our men brighten with hope. It passes over our heads. Soon it begins to descend, but with a rapidity that arouses renewed apprehension. Quickly a squad of cavalry, led by Captain Locke, Lieutenant McQuade, of the General's staff, plunge spurs into their horses and dash away in the direction of the descending balloon. The rest of the story is as I received it from the General's own lips. While the rope was being paid out he adjusted his glass, in readiness for his proposed view of the enemy's territory. A sudden bound of the balloon told him in a moment that the rope had given away. He dropped his glass, heard the call, 'Open the valve,' made the response given above, and set about looking for the valve.

"He was sensible of being flighty (the General loves a pun as well as the next one), but was not at all nervous. He saw the wind had taken him over the line of the rebel entrenchments. Having no wish to drop in among them, he let the valve take care of itself, and proceeded to take advantage of his position to note the aspect of rebel objects below. Crowds of soldiers rushed from the woods, and he heard their shouts distinctly. Luckily, he was above the reach of their bullets, so he was not afraid on this score. The map of the country was distinctly discernible. He saw Yorktown and its works, York River and its windings, and Norfolk and its smoking chimneys. A counter current of air struck the balloon, and its course was reversed. Its retreat from over rebeldom was rapid. He opened the valve, the gas escaped, and down he came. He could not say how fast he came down, but it was with a rapidity he would not care to have repeated. The

car struck the top of a shelter tent, under which luckily no one happened to be at the time, knocked the tent into pi, and left him enveloped in a mass of collapsed oil silk. He crawled out, and found himself in the middle of a camp, not one hundred rods from General McClellan's headquarters.

"'I came mounted, you see,' was his remark to General Burns, who was about the first man by his side. He gave the details of his aërial voyage to Gen. Burns, who, seeing the opportunity of getting off a joke, could not lose the opportunity.

"'You are a suspicious character,' remarked General Burns.

"'How so?' asked General Porter.

"'In the space of half an hour you have been taken up by a balloon and arrested by a shelter tent.'

"'And you have come down safe, I see,' broke in Captain Locke, before the laughter of General Burns' duet of puns; 'I came with this cavalry company to look you up.'

"'You ought to have sent flying artillery after me,' rejoined General Porter."

# CHAPTER XLIX.

Balloon meteorology—Cloud phenomena—Importance of investigating them—Safety of ballooning.

AS I desire in this chapter to set forth the importance of regular meteorological observations in the upper atmosphere, I will combine the results of a number of aërial voyages. Some of the particulars here given have been mentioned in other places, but this will, I trust, not make them less interesting in this special connection.

In the science of meteorology there is no instrumentality competent to do so much good and which has as yet received so little attention as the balloon. The phenomena of the atmosphere, in their relations to climate and sanitary effects, to agriculture, to physiology, to our mental forces and temperaments, are more fertile in scientific developments than an observer from the earth would suppose. Meteorological investigations are as occult, tame and spiritless without the aid of an air-ship as would be hydrographical investigations without the water-ship. The deep-sea soundings, so pregnant with interest in their revelations of infusorial life at the bottom of the ocean, find their counterpart in the deep-air soundings in the opposite direction, in the myriads of vegetable life floating upon the currents of the atmosphere. It is not an uncommon thing to see the air-currents above the clouds teeming with thistle seed, each one with its silken parachute, sailing along in grand procession. And so, too, is it with the pollen of other plants, moving along in little nebulous cloud-patches.

The upper air is not so barren of scientific interest as its apparent vacuity when viewed from the earth would indicate. It is a marvel that so fruitful a subject, and one so easily to be explored, is so much neglected. The science of light seems almost reversed in looking down through the atmosphere to the earth from an insulated position of two or three miles of altitude. The earth looks concave, and the horizon is loomed up above the level of the observer. Sometimes a city five or ten miles off may be seen hanging in the heavens upside down, and illuminated by three suns. When this phenomenon presents itself above the cloud-region, it is more distinctly defined than when it occurs near the surface of the earth.

The phenomena of the clouds are full of interest. Some are dense

and some are attenuated. Some are warm and some are cold. Some are light and some are dark. Some are charged with ozone. Passing through an ozone cloud causes hoarseness; it acts upon the mucous membranes, and is first perceptible by smell and the twinging sensation it produces upon the cuticle of the hands and face. When the balloon comes near a cloud, electrical excitement takes place; it also occurs when the balloon is passing from one current of air into another. The finer part of the light sand-ballast used by the aëronaut is drawn in a stream from the car up and against the body of the balloon. Also the fine-cut index paper used by aëronauts is, in such cases, drawn up against the balloon, hanging there for a while with a tremulous motion, and then falling off. I have heard it making a crepitating noise when thus thrown out by handfuls. The stillness is so profound above the clouds that a noise not perceptible on the earth is quite discernible there.

It is remarkable how suddenly, at times, the currents of air strike the balloon, causing it to swing slightly to and fro, as well as to rotate on its vertical axis. These sharp crossing-currents are always attended with marked electrical evolutions. The gas in a balloon, that is perfectly transparent when it leaves the earth, is changed into a cloud when it gets into a region of clouds, and it assumes this character of cloud in a perfectly clear atmosphere, when the balloon reaches the region of frost. I have had my hair thickly covered with hoarfrost on a Fourth of July, and cloud issuing from the neck of the balloon, at an elevation of 19,000 feet.

The atmosphere is always clear and transparent after a rain-storm; it is only then that an observer aloft has a great scope of view of mundane objects. On such occasions the view in ascending from the seashore is very imposing. It is well known that from the land, or the surface of the sea, a ship is not visible when twenty miles off. The earth's convexity being about eight inches to the mile, and this obstruction of convexity increasing as the squares of the distances, limits the sight of a ship within moderate scope. Thus, in ascending from a place like Boston harbor, the scene becomes very interesting. As you gradually go up, so come up the ships behind the horizon. It looks like magic. Of a clear day you can see ships at sea a hundred miles off, when the sun is in the opposite direction. With cloud fields between the observer and the ships, they have the appearance of sailing above and over the clouds. So the meandering of a river is sometimes seen convoluting itself over and under the clouds in the distance. These unique sights are of course optical illusions, but without a knowledge of the science of optics would be deemed mysteries. They prove, however, how subject we are to be misled by our senses in cases where science is not available to correct their errors.

The most marked difference between an earth-view and a sky-view occurs in the storm-cloud. The nimbus, or thunder-cloud, when viewed from the earth-level looks like an agitated and confused mass of leaden-colored vapor. When viewed from a little above its level,

and from a few miles' distance, it looks symmetrical. Bulged out above and below, and contracted in its middle, it trails along over the earth like a huge smoking, fuming engine, dragging its lower part slightly behind, like the trail of a court-lady's garment. The electrical cannonading as it passes along gives it quite a grand and imposing effect. It is quite practicable to sail above, behind or in the midst of these imposing meteors. Sailing behind one, and between its upper and lower cloud, I saw a beautiful prismatic-colored grotto, and apparently from within this grotto came terrific peals of thunder. This grotto was no doubt produced by the refractive power of the gas in the balloon, as the sun was shining in between the upper and lower cloud, and through the balloon, and the grotto appeared on the opposite side of it—that is, the grotto was on the east side and the sun on the west side of the balloon, and it was late in the afternoon. That such was its cause is inferred from the fact that prismatic circles of light had appeared in the upper cloud surface when the sun's rays passed through the gas of the balloon when sailing above it. This phenomenon only occurred with a silken balloon; silk becomes transparent when varnished, cotton does not. A silken balloon is also more susceptible of electrical excitement than one of cotton. A silken flag crepitates in passing from one current of air into another—a phenomenon not perceptible in a cotton one.

Storm-clouds do not all discharge thunderbolts. When a certain field space of atmosphere contains a number of them—and I have seen seven at one time, small ones—they deposit rain in fitful showers, but discharge no thunderbolts. When two or more of them coalesce, then discharges of electricity follow. These detached nimbus clouds are prevalent in the months of April and May, and produce what we term "April showers."

During the heat of summer the thunder-gust proper prevails. Its constant attendant is heat. We all know from common experience the precedent suffocating heat before a thunder-gust. When these meteors are generated suddenly, they give out snow, hail and rain. Snow melts partly into hail and partly into rain. Hailstones contain in their centre a nucleus of snow. In rising up from the earth the deposition from a cloud grows diffuse, more and more, until you enter the base of the cloud, where it is a dense mist, and as you rise in the cloud this mist becomes thinner, until near the top, when it ceases entirely; at this point the cloud becomes warm, and when emerging from its top still warmer, caused by radiation and reflection, and then follows a twinging sensation in the cuticle of the face and hands like the pricking from bunches of needles, also slight hoarseness, with more or less pain in the base of the brain and in the ears when the ascent is sudden.

It is impossible to hold a level position in the body of a thunder-cloud. You are all the time going up or down. The vortex current carries you up through the central part of the cloud, diverging the

balloon outward with the outspreading vapor, upon which it describes its outward and downward course, generally to be drawn in again near the base of the cloud, and from thence upward on the uprising stream, and so on like an endless chain, until you leave it by an increase of levitating force from its top, or an increase of gravitating force at its base; in the one case by a copious discharge of ballast, in the other by a copious discharge of gas.

To explore one of these meteors is at first calculated to produce a degree of anxious solicitude; but when experienced for a while and duly considered, the experience becomes interesting and sublime, and well calculated to inspire the meteorologist with a desire to renew the investigation of atmospheric phenomena.

There is no disk rotation in a storm-cloud, but there is a vorticle rotation in its centre caused by the two forces of the inrushing and uprushing air, shown in the swinging and rotating motion it gives to the balloon. This inward motion of the air toward the vortex of the cloud extends beyond the outer margin of the meteor, and will gradually draw the balloon toward and into the vortex. This can be prevented by giving the balloon an upward or downward motion, as in either case the centre of the storm will recede from the air-ship, and thus we have the power of riding in the wake or in the midst of a thunder-gust.

It may be deemed a hazardous mode of investigation to sail up into the air three or four miles high; but when we take into comparison the number of air-voyages made, and the accidents related to them, we shall find as favorable results as in sea-voyages. I have accounts of thirteen balloons that exploded while high in the air with their occupants, two of them with myself while above the clouds, and in none of these was any one harmed. The law of atmospheric resistance is as certain as the law of atmospheric buoyancy. I even controlled the collapsed descending balloon from falling into a piece of woodland by lightening the weight in the disposal of ballast, and thus drifted beyond the trees.

So far as I have investigated accidents with balloons, not a single case occurred from any intrinsic principle of danger connected with the art. Not so with the sea-ship. There the two elements wind and water, coming in conflict, cause the destruction of the vessel. Water nearly a thousand times denser than air, and the air moving against the ship with a velocity of a hundred miles per hour, and the immense mast leverage, must necessarily bring a tremendous force upon its framework. Not so with the air-ship. It has but one element around it; and once free in the air, it matters not, so far as its ability to stand the strain is concerned, whether the wind moves one mile or one hundred miles per hour. Even with the latter velocity your vessel glides along so smoothly and gracefully as not to ruffle a cobweb suspended from its flagstaff. Did you not perceive objects on the earth receding and approaching, it would be impossible to discern that

you were moving at all. I travelled forty miles in forty-eight minutes in the midst of a cloud stratum without being aware that I had moved forty rods before landing.

When accidents have occurred with balloons, they were always attributable either to defective construction or a want of ordinary skill in the persons operating them. It is a deplorable truth that many if not most persons who use balloons are not scientific. And yet this class have generally to relate the most marvellous stories of blood oozing from their finger ends, and the balloon turning topsy-turvy, and the miraculous escapes they have made.

When it is considered that we do not know precisely to this day the source of electricity in cloud phenomena—whether in storms it is a primary or a resultant; whether there is one kind or two kinds developed in a thunder-gust; whether the thunderbolt makes its detonation forcing its passage through the air, or in its percussion upon more solid matter; whether the bolt darts from one cloud to another, or whether it invariably darts to the earth—we should use all reasonable means to find out. The European scientists shot arrows into the air to learn something of atmospheric electricity. Franklin, always practical, not being able to get up into the clouds himself, sent up his representative, the kite, and in a moment demonstrated a fact which for a thousand years had been held in abeyance—the identity of cloud and machine electricity. The great philosopher, fearing the ridicule of the unlearned over a man flying a kite, went clandestinely out to Bush Hill, under cover of his son, to try the mission of his aërial messenger, and it proved and settled the long-mooted question.

The air-ship is destined to settle the question of the relation of atmospheric with terrestrial electricity, and how this all-pervading agent—gravitation *per se*, or intrinsic motion, or vis-vitæ, or whatever we may term it—is to be appropriated to our common welfare; for in it we live and move and have our being.

A JULY SNOW-STORM IN THE CLOUDS.

## CHAPTER L.

Ascent from Chambersburg, Pennsylvania—In a snow-storm on a hot July day—A curious atmospheric experience.

ON the 29th of July, 1871, I made an ascension from Chambersburg, Pennsylvania, in the balloon "Gambetta," accompanied by Mr. Augustus Reineman. The balloon left the ground at 3.15 P. M. After rising to an altitude of five to six thousand feet, with a little deviation from a perpendicular, experiencing during the ascent slight breezes fluttering around, and very rapid increase of cold, much beyond the ordinary change in such cases, we encountered a large concave cloud, of a pale, dingy color, which involved us in a shower of snow. At first I surmised that some peculiar action of the balloon, coming up with warm gas from the heated atmosphere below, was playing the part of an ice-making machine, but upon more careful observation, in looking against the dark background of the mountain before us, discovered that the cloud, which covered an area of perhaps a thousand acres, and was oblong in shape, was doing the work. The cloud-vapor was extremely attenuated, and it was only after we entered several hundred feet into it that we lost sight of the earth below. Here we encountered another extreme of temperature. While ten minutes before we were shivering with cold, we were now experiencing fiery heat —so much so that around our necks it felt like being pricked with red-hot needles. Still, in this prickly air, our breath smoked like in a cold, frosty morning.

Having lost sight of the earth below, and having not yet reached the upper current, and the balloon distended to its utmost limit, smoking at the safety-valve, I suffered it to sink back into the cloud. When we came out below, we discovered that Chambersburg had followed us or else we had gone back on Chambersburg, as it was now immediately underneath. It was still snowing slightly from the cloud. Immediately as we came out of the cloud below we became hoarse, and Mr. Reineman, as well as myself, suffered extremely in the windpipe. The cold also was much more intense than before, causing my teeth to chatter and my whole frame to tremble from the chill. My companion suffered from general cold, particularly in the feet. Our ears also were suffering from the change—indeed, the pain to me was excruciating,

and I therefore commenced a rapid descent, the temperature becoming more agreeable as we neared the earth.

We landed at half-past four, having been aloft one hour and twenty minutes—half an hour of the time in a snowy atmosphere.

At our greatest altitude, eight to nine thousand feet, we saw high above us a stratum of fine cirrus clouds, with an intense blue atmosphere peering behind them. To our right and to our left, some miles distant, two nimbus or storm-clouds were visible, and from their peculiar form and color we took them to be snow-clouds similar to the one we encountered. There was also visible in the distance a regular thunder-storm, accompanied with lightning and thunder, showing great agitation in its mass of vapor, while our snowing nimbus was as gentle and serene as the great mountain ranges on either side of us.

This ascension was made during one of the hot July days in which thunder-gusts abound. All day it was close and sultry; and when the balloon was released from the earth, a thunder-gust was approaching the town. The start was made with the intention of penetrating the storm-cloud if possible, and it is due to the courage of my inexperienced companion to say that when I informed him of it he replied, "I am willing to go; if you can stand it, I will try and do the same."

One of the peculiar meteorological features of this occasion was the proximity of the snow-cloud to that of the thunder-gust. We were much higher than the thunder-gust when we entered the shower of snow. The thunder-gust was moving rapidly along while the snow-cloud was standing still.

There was a conjunction of meteorological phenomena. A very hot day with thermometer at 90. A thunder-gust passing overhead; above this a snow-storm and intense cold, and above this a cluster of cirrus clouds.

After the descent, three miles from Chambersburg, I passed the balloon into the hands of my son Charles E. Wise, who, with his son John Wise, ascended from the place of my descent, the atmosphere being in a favorable condition for aëronautic field sports, and pleasantly was it used that day. In the evening another ascension was made with the balloon from the town by C. E. Wise; the matter had been arranged by Thad. Stevens, Esq., who had come over from his iron-works for a day's recreation. The balloon and its voyager finally landed six miles south of the town.

## CHAPTER LI.

Ascent from Gettysburg, Pennsylvania—My 446th aërial excursion—Over the battle-field—A novel experience.

WHEN, in September, 1842, I made an ascension from Gettysburg, and was so much interested with its beautiful geographical locality, perched as it is upon a natural mound, with surroundings of farm-checkered plain and contiguous knobs, and its natural rock fortification of Cemetery Ridge as a central crowning point, I little thought that the womb of the future would give birth to its classic glory wrung from the grandeur of bloody-handed war, and, worse than all, intestine war. Twenty-nine years thereafter, in October, 1871, I looked down from balloon-height upon the same landscape again, and found the little old cemetery, the family resting-place of the Gettysburg people, nestled in the midst of one of the most beautiful burial-grounds in the land, crowned with a centre-piece of architectural statuary, the handsomest I ever saw.

History, Peace, Plenty, War, Victory, all grouped upon the same pile, Victory looking as righteous as a consecrated virgin, whilst amiable, modest-visaged Peace sits humbly below.

Oh that a higher civilization may transpose these feminine allegories, and let Peace be the apex, and allow Victory the subordinate place of triumph in the more noble advance of her legitimate claims—art and science!

The thought occurred to me as this scene was glimmering in the mellow depth of an October evening: "What a desperate determination that must have been that inspired Lee's forces to attempt a capture of Cemetery Ridge! a naked acclivity over which to march into the teeth of rock-sheltered artillery and infantry, with nothing but the compact little borough of Gettysburg for a cover. This interesting topography, so beautiful in itself, and now made doubly interesting and grand with its historical embellishments, must for all time to come make it, as it is, a place of interest and attraction to all people that travel for the sake of beholding the interesting and the grand. Farewell, Cemetery Ridge, with all your beautiful environs. The sun is now flooding you with his declining golden beams, as the noble ship 'Gambetta' is lifting me into a murky stratum of warm fog at an ele-

vation of two miles, growing warmer as we go higher. This is not often the case in aëronautic experience."

While the sun was gossamered on the margin of the horizon in the west, the whole eastern heaven was embellished with richly colored bands of faintly outlined prismatic lines. It was mirage upon a grand scale, occupying half of the horizon circle. It was warmer at the height of two miles than on the surface of the earth. Not even when the sun sank out of sight did this temperature in the fog diminish. Disposing now of half my ballast, about thirty pounds, the "Gambetta" mounted up a mile higher, bringing up a rising sun in the west, producing all the phenomena of early morn, and with it a little of the fresh air concomitant to October sunrise. I sailed along at this height until the sun again sank below the horizon, upon which the gas began to shrink so rapidly that it required a gradual disposal of my remaining ballast to keep afloat. I regretted this very much, as I was now moving in the direction of York and Lancaster, with the picturesque Susquehanna in full view for fifty miles of its length, glaring its bright surface through the attenuated stratum of warm fog. The river was loomed up, jutting up as it were above the level of its elevated shores.

When I started from Gettysburg, the railroad train immediately followed, and when I got a mile above the earth the train looked like a huge black snake wriggling along, now to the right and then to the left, and kept up quite a lively competition of speed, until I reached a current from the south-west, when we parted company, and thus I passed Hanover to the north, but in full view of the place, leaving the railroad train trailing its length into the town, announcing its arrival with lively strains.

At my greatest elevation I could distinctly hear the barking of dogs, the shrill toots of the locomotive and the report of guns, the fog appearing to act as a tympanum.

As the balloon was gravitating from the shrinkage of the gas, I gradually disposed of my remaining ballast in order to get as far east as possible. Through the latter part of the voyage I was constantly greeted with cheers and invitations to "come down," and in the fading twilight I passed York, landing three miles east of the town.

My ballast was mainly expended in feeling the way up to find out how high this increase of warmth extended. I discovered it to be up to the top surface of the fog, from which point it grew colder as I ascended. The fog was up to the height of over two miles, but was very thin in its consistence, and felt dry.

It is worthy of remark that in this ascent was experienced what had never before occurred to me in my nearly forty years of air-voyaging. While it always happens that a genial warmth is felt when passing up through a cloud as you near its upper surface, I found in this instance the air growing warmer from the earth's surface up to the top of the fog.

Another peculiarity of the phenomenon was observable in the fact that while the fog was well defined in its upper limit, it was so attenuated that the surface of the earth beneath it was clearly distinguishable, but with an exceedingly mellow aspect. The rise of the sun, as seen through the fog, was clearly defined, like that of a full moon, and could be viewed without pain to the eye.

A balloon could not sail over a more beautiful region of country. Between Gettysburg and York it is a continued landscape of farms, with comparatively little woodland interspersed, and nearly all the improvements of buildings are white. It will soon be a continued village.

The pleasure of this trip was enhanced from the fact that I suffered no inconvenience from the rarefaction of the air, though I attained a height at which the atmospheric density had diminished to half of its weight at the surface of the earth, and the balloon had swollen from a little over half full to its uttermost distension, and that alone prevented me from going higher.

The atmosphere above the fog grew colder as the balloon ascended higher, while the objects on the earth seemed to become more clearly outlined, but, as mentioned above, in a peculiarly subdued kind of illumination.

The town of York, three miles beneath me, appeared so very small that I could not realize its identity until I had descended. It was the most beautiful miniature picture of a town I ever saw in all my experience. Its peculiar appearance was attributable to the nature of the gossamer mantle that overhung it.

## CHAPTER LII.

Spontaneous combustion—The conditions under which it is likely to occur—The necessity for guarding against it.

BALLOONS, when injudiciously prepared with the oil varnishes, are liable to spontaneous combustion; hence a short treatise upon that phenomenon may be considered as coming within the province of a book that is in part devoted to instruction in making balloons.

Astronomical science teaches us to believe that nebulous matter in interstellary space may exist in such a form as to be susceptible of condensation into particles like rain, hail and snow in our atmosphere, and in that way produce magnetic storms known to us as auroral displays, showers of stars, falling of aërolites in the condition of agglomerated iron and nickel, and of diffused cosmical matter so minutely divided as to defy detection by microscope, but cognizant in its effects upon animal organisms. Eminent physicists go even so far as to teach that the comets may degenerate into chaotic dust, to be scattered about ready to be rained down on any planet that happens to wander within its sphere of gravitation, and that this matter takes fire in our atmosphere by spontaneous combustion, just as phosphuretted hydrogen takes fire when it is evolved from the marsh-ground of the earth.

But let us come down to our habitable level and examine the subject more at home, and where it often produces mischief and loss in what we consider a kind of mysterious incendiarism. From all we can learn by the light of chemistry, combustion is the result of a union of oxygen with other combustible matter. I say combustible matter, meaning by this that which enters into chemical union most readily; nevertheless, all matter is combustible if you make the fire hot enough. Some substances enter into combustion explosively, as, for instance, gunpowder, dynamite, oxyhydrogen, some of the carbon oils, etc. These are compounds of rapid and energetic deflagration, and may be classed as extremes of vigorous combustion. Then we have an extreme of slow combustion found in the decay of vegetable matter and in the phosphorescent insect, in all of which the chemical action is so slow as to cause hardly any perceptible heat. This species of phenom-

enon is technically termed *Eremacausis*, a Greek word meaning slow combustion.

We have thus before us various kinds of combustion, very marked in the fact that while one kind is always subject to ignition from a living spark, others take place without such application and fire up of their own accord. The latter we term spontaneous combustion. In the case of eremacausis, there is at no time active fire developed, and the matter so consumed is reduced to its ultimate débris by a continued slow process. Spontaneous combustion, holding a middle rank between the two extremes, begins imperceptibly and increases gradually, heating more and more, until it bursts out in active and vigorous fire. Without attempting an explanation of the cosmical cause of combustion, since that would seem as difficult as it would be to find out what gravitation is, it will be in order to describe various forms in which it presents itself to us in facts of mysterious origin, so that we may be guarded against loss of life and property springing from conflagrations caused by spontaneous combustion. The following are prolific sources of fires ascribable to this phenomenon: Fibrous materials saturated with vegetable oils are liable to spontaneous combustion. Cotton and woollen rags used as wipers of oiled iron machinery, when thrown on a pile, will fire up spontaneously. Oiled silk, when not thoroughly dried out and rolled up in considerable quantity, will heat and burn up. I have packed it up in the evening and found it in a blaze of fire next morning. This happened during a sudden change of atmosphere from cold to warm in the month of March. A pine stick that had been used in scraping up soap-fat was stuck into a barrel of wood ashes, and by the next morning the ashes were in a red-hot glow of fire around the stick. In another case it took place in this way: Having used some wooden casks for the generation of hydrogen gas by the mixture of iron turnings, water and sulphuric acid, with an excess of iron, after the liquid was poured out the remaining iron heated up spontaneously and set the casks on fire. These casks had formerly been filled with whisky. In another case it happened by a little hot linseed oil being spilled into a canister of pulverized charcoal, which took fire through the night. Some of the same oil was splashed on a woollen blanket which was thrown carelessly into the corner of a shed, and within six hours the blanket took fire.

Sawdust saturated with linseed oil will fire up spontaneously; so will bituminous coal piled up in a wet condition in large quantities, especially if oiled rags or scraps of iron happen to get on the mass. New-shelled corn put up in large piles will heat and fire up; so will under-dried hay put in the barn or stack in large quantities, and more readily if an iron fork or other iron material gets in the mass. Iron turnings, borings or filings, mixed up with flour of sulphur and buried in the earth, will ignite spontaneously and belch up as a miniature earthquake. Iron dust is more combustible than wood dust. Spirits of turpentine and benzine will take fire from a drop of concentrated

acid. There are authenticated cases of spontaneous combustion of the living human body of persons whose systems had become saturated with alcohol. While there may be a reasonable doubt of the spontaneity, it can hardly be disputed as a condition for facile ignition, followed by combustion of the body. We have here presented a sufficient variety of forms of spontaneous ignition and combustion to warrant the belief that many, if not all, the cases of mysterious conflagrations that have happened owed their origin to one or the other of such causes.

There are, however, other sources of conflagration kindred in their relations as to mischief to that of spontaneous combustion. Wooden casements in close proximity to gas-lights and steam-pipes long continued become as susceptible of ignition as tinder, and so do the ends of wooden girders resting on brick walls and separated from the chimney flue by the thickness of a brick not well cemented around with mortar. Fires too often occur from these careless and dangerous fixtures where the smallest spark is sufficient to ignite.

Facile ignition and spontaneous combustion are the prolific sources of disastrous conflagrations, and a competent inspector of combustion in large cities would prove an economical agency to fire insurance corporations and property holders. There are other conditions of spontaneous combustion not mentioned, but those enumerated are most to be guarded against in our domestic and commercial affairs.

Taking the phenomenon of combustion from its most facile forms, as in percussion and spontaneity, to that of the more difficult forms as presented in the non-combustible substances of earths, we have as many grades and degrees of ignition from the one extreme to the other as we have different shades and lines of light and dark in the solar spectrum when analyzed, and it may be yet learned that the actinic rays of motion play an important part in the phenomenon of spontaneous combustion. The light rays we know to be capable of ignition by concentration and by reflection. Before the invention of friction matches the old-fashioned pocket "sun-glass," used to light cigars, attested the one, and the mirrors of Archimedes the other. The actinic rays, even more subtle than the other, prefer to do their work under a dark mantle.

While the science of fire, as laid down in the books, is explained in the reaction of oxygen and combustible matter, it is well known that the naked condition of oxygen and combustible matter in contact will not produce the phenomenon. Even in that of the atomic equivalents of hydro-oxygen, in which we find the highest order of deflagration, combustion will not take place without the application of a living spark to induce the chemical reaction. In the mystery of that catalytic spark rests a volume of unknown philosophy.

Spontaneous combustion is all the time going on in our blood in the chemical union of the carbon of our food with the oxygen taken in through the lungs. Stop the carbon or the oxygen, and the fire goes

out; and what follows is illustrated in the coffin. We can make an interesting and pleasing experiment of this living fire in our bodies by the following process: In cold winter weather—all the better during a dry snow—and in a chamber of dry atmosphere, by walking slidingly and with as much muscular action as possible, one can readily ignite a gas-jet by bringing the finger or knuckle within spark distance of the burner so that the spark passes through the gas. More readily can it be done if a person in a woollen coat be rubbed by another with a fur muff, and still more readily by a person standing on a silk handkerchief and having himself charged with an electrical machine, be it ever so small.

It is a wonderful fact of chemistry that while our life depends on spontaneous combustion in the blood, and that when this process ceases vitality is gone, the combustion termed eremacausis commences on the muscular fibre and bones, and reduces the whole body into ashes. The same elements of nature that play the drama of life turn round in an instant and play out the tragedy of death.

# CHAPTER LIII.

Lightning and its identity with electricity—Experiments of Franklin and others —Professor Henry's investigations—Silent lightning.

THE science of electricity is of so much importance, and my facilities for the observation of electrical phenomena have been so great, that this work would scarcely be complete without some remarks upon the subject.

In all ages of the world mankind has viewed the thunderbolt with fear and trembling, more from its awe-inspiring impressiveness than the frequency of its destructiveness. When the heavens are darkened and the clouds roll to and fro, and the quick flash of the thunderbolt darts athwart the black background at an inconceivable velocity, with its barbed fire, and the roaring thunder follows like the rumbling of a thousand carriage wheels, it makes even the philosopher stand in wonder-stricken silence as he contemplates this sublime phenomenon, speaking in the majesty of its nature.

The Thracians used to shoot their metal arrows at it in order to disperse its fury. The Etruscans pretended to have a secret method by which they could draw lightning from the clouds and guide it at their pleasure. Numa was the possessor of the method, and Tullus Hostilius, making a blunder in the performance of the ceremony, was himself struck.

The ancient poet says:

> "Before their sovereigns came, the Cyclops strove
> With eager speed to forge a bolt for Jove,
> Such as by heaven's almighty Lord are hurled,
> All charged with vengeance, on a guilty world."

In modern times, while much of this terror still exists, science and close observation have shorn it of much of its dire alarms. Less than two centuries ago the Church assisted in augmenting the fears of the people of civilized Europe upon this subject. The towering steeples of their places of worship, being oftener visited by the thunderbolts of heaven than other buildings, gave them the notion that Satan was the author of these fearful atmospheric disturbances. Consequently, it became the custom in many parts of Europe to ring the church bells

when a thunder-storm was approaching, in order to scare away the demon of the air. Sometimes the men at the bell-rope were struck down, and then it was conceded that the devil got the upper hand because the ringing had not been vigorous enough. We have an instance recorded of eleven men receiving a thunderbolt while ringing a ponderous bell in the town of Chaubeul, near Valence, seven of them being struck dead at the bell-rope. These men, however, were ringing for another purpose than scaring away the devil.

When a building under the protection of a lightning-rod is shattered by the thunderbolt, the rod-men say it was not put up right, getting out of the dilemma as did the bell-ringers. Nevertheless, the erection of lightning-rods goes on with very little deviation from those that failed to scare away the demon of the air.

Thus the investigation of lightning, the thunderbolt, hot and cold strokes, the lightning-rod and thunder-storms, is one fraught with interest and worthy the attention of every intelligent person. In taking up its line of history and its most thorough scrutinizers, we shall find Benjamin Franklin, the humble tallow-chandler's son, standing most prominent among the brilliant intellects who earnestly entered this domain of physical science. He was one of the first in the list of philosophers who proposed to disarm the thunder-clouds by exhausting them of their fulminating ammunition by the strategy of the lightning-rod. And he was one of the first men in the world to prove the identity of the lightning of heaven with the electricity developed by friction on glass, and that they were both one and the same kind of matter. Being of a peculiar utilitarian turn of mind, he expressed a strong desire to turn these discoveries to the common use of mankind.

Dr. Lardner says that the identity of lightning with electricity was suggested by Dr. Wall in 1708, by Mr. Grey in 1735, the Abbé Nollet in 1748, Franklin in 1749, MM. Dalibard and Delor in 1752.

Franklin addressed a letter to Mr. Collinson in 1749, in which he says: "Chagrined a little that we have hitherto been able to produce nothing in this way of use to mankind, and the hot weather coming on, when electrical experiments are not so agreeable, it is proposed to put an end to them for this season somewhat humorously in a party of pleasure on the banks of the Schuylkill. Spirits, at the same time, are to be fired by a spark sent from side to side, through the river, without any other conductor than the water, an experiment which we some time since performed to the amazement of many. A turkey is to be killed for dinner by the electric spark and roasted by the electrical jack,* before a fire kindled by the electrified bottle, when the healths of all the famous electricians of England, Holland, France and Germany are to be drunk in electrified bumpers, under the discharge of guns from the electrical battery."

In a subsequent letter, bearing date 1753, to the same person, he says: "In my former paper on this subject, written first in 1747, en-

* A little revolving machine worked by electricity, the invention of Franklin.

larged and sent to England in 1749, I considered the sea as the great source of lightning."

M. Arago, who disputes the claim of Franklin as the discoverer of the identity of electricity and lightning, says: "If the experiment were necessary or useful, science owes it to M. Dalibard, who executed it at Marly-la-Ville a month before Franklin made it with his kite at Philadelphia." Now, the fact as stated by M. Dalibard himself was that he took Franklin's printed directions in performing it. He put these directions into the hands of an old retired soldier, named Coffier, a carpenter by trade, who put up the conductor for it. The spark was drawn by Coffier while Dalibard was at Paris. This experiment took place on the 10th of May, 1752, and in June following Franklin drew down the lightning spark from the clouds, during a thunder-storm, with his kite.

Now, Franklin, having noticed that thunderbolts had a peculiar tendency to lodge on points or projections, particularly on the tops of high masts, the spires of churches or the corners of roofs—indeed, all projecting bodies pointing toward electrified clouds—was led to the idea of the lightning-rod.

Upon this he says, in one of his letters, "If these things are so, may not the knowledge of this power of points be of use to mankind in preserving houses, churches, ships, etc., from the stroke of lightning, by directing us to fix on the highest points of these edifices upright rods of iron, made sharp as a needle, and gilt to prevent rusting, and from the point of these rods run a wire down the outside of the building into the ground, or down round one of the shrouds of a ship and down her side till it reaches the water? Would not these points probably draw the electrical fire silently out of the cloud before it came nigh enough to strike, and thereby secure us from that most sudden and terrible mischief?"

Such was the reasoning of Franklin after the identification of electricity and lightning. He continued to investigate with zeal and determination all its phenomena, with a view to render the new discoveries of its laws and nature useful to mankind. Having an extensive correspondence with eminent scientists of Europe, his letters upon electricity to his friends there always incited a lively interest upon the subject, notwithstanding the Royal Society of London looked upon some of his notions as absurd and ridiculous. They refused to give them admission in the "Philosophical Transactions." Dr. Fothergill, however, thought them of so much value that he wrote a preface to them, and had them published in pamphlet form, and they became so popular as to pass through five editions. A few years later this same learned institution conferred upon him the highest honor in its gift, by voting him the Copley medal and unanimously electing him an honorary member of their society in 1753.

King George the Third, in order to gratify his spleen against American genius, had blunted, instead of pointed, lightning-rods erected upon

his royal palace, of which Franklin wrote to a friend in England that "the king's changing his pointed conductors for blunt ones is a matter of small importance to me. If I had a wish about them, it would be that he would reject them altogether as ineffectual. For it is only since he thought himself and his family safe from the thunder of heaven that he has dared to use his own thunder in destroying his innocent subjects."

In regard to the rod for shielding buildings from the thunderbolt, Franklin believed that it must tower up high in the air, and with this view he was then awaiting the erection of a high church steeple in Philadelphia. He never once suggested the idea that a lightning-rod should be struck, but that its office should be to carry the lightning from the electrified cloud down into the earth silently, and thus, by its diffusion in that way, restore the electrical equilibrium between the thunder-cloud and the earth.

He said: "To determine this question whether the clouds that contain lightning be electrified or not, I would propose an experiment to be tried where it may be done conveniently. On the top of some high tower or steeple place a kind of sentry-box, big enough to contain a man and an electrical stand. From the middle of the stand let an iron rod rise and pass, bending, out of the door, and then upright twenty or thirty feet, pointed very sharp at the end. If the electrical stand be kept clear and dry, a man standing on it, when such clouds are passing low, might be electrified and afford sparks, the rod drawing fire to him from a cloud. If any danger to the man be apprehended, let him stand on the floor of his box, and now and then bring near to the rod the loop of a wire that has one end fastened to the leads, he holding it by a wax handle, so that the sparks, if the rod is electrified, will strike from the rod to the wire, and not affect him."

This is one of the propositions that the Royal Society laughed at, and which was deemed too absurd to be entered upon the records of the "Philosophical Transactions." In this proposition we have all the science of the lightning-rod in a nutshell. It must project up with its point near to the thunder-cloud. It must draw or tap the surcharge from the cloud silently. It must not be struck by lightning. Such was the philosophy of Franklin in regard to the lightning-rod, and that philosophy cannot be logically controverted. When the clouds run low enough to nearly scrape the top of the lightning-rod, it will discharge them silently; but that is a circumstance and condition of the atmosphere that rarely, very rarely, happens. Owing to the manner in which lightning-rods are constructed and put up, they do not shield property from the thunderbolt when the clouds do run thus low. Their terminal extremities not presenting metallic surface sufficient to diffuse and spread it out so as to neutralize its tension, the consequence is an explosion from recoil.

Franklin was also the first man to elucidate electrical induction; as, for instance, if one side of a pane of glass is positively electrified, the

other side will become negatively electrified—that is to say, just in proportion as you increase the electricity on the one side over its normal portion, the opposite side will lose an equivalent portion of its normal quantity. This demonstration established the doctrine of minus and plus electricity, termed positive and negative, in place of that of the celebrated Dufaye, which was based upon two kinds—namely, vitreous and resinous electricity.

The impetus given to electrical investigation in Franklin's time, with a view to explain its various phenomena, gave rise to many curious suggestions. And in our day, with the invention of the Holtz electrical machine and Rumkorf coil, we are in a fair way of having the Franklinian energy renewed.

The following is a condensed report of a discourse by Prof. Henry before the American Scientific Association, sitting at Newport, Rhode Island, in the summer of 1860. It embraces observations which I made while in the midst of thunder-storms, which from time to time were communicated to the secretary of the Smithsonian Institution. The report says: "The conclusions as to the causes and accompanying phenomena of thunder-storms gratify by their simplicity and distinctness. He first stated the many theories which from time to time had been given relating to the origin or source of the subtle fluid, electricity. It was thought to be produced by the friction of the currents of air in motion. It had also been attributed to growing vegetation; also to evaporation. It was well known that boiling salt water produced electricity. Steam blown off from a locomotive was a source of electricity, but it was frictional. Upon the whole, the origin of atmospheric electricity was not conclusively ascertained. There is a theory that the atmosphere is not electrical *per se*, but only by induction—that the earth is electric, and the air only electric under certain conditions. This was Pelcher's theory.* It had been adopted by some European physicists, and he must say it had not received the attention deserved. The late Dr. Hare, of Philadelphia, entertained a similar theory—that the earth was plus electrical and the air minus.

"It was certain that the amount of electricity in the air varied with the amount of vapor present. On clear, dry, cloudless days there was but little electricity to be detected by the electrometers, and it was only when we had masses of vapor in the form of clouds that there were electrical discharges. If a polished iron rod, two or three feet in length, with a polished brass knob at each end, be held horizontally, there will be no sign of electricity in the rod; but if it be held vertically, it instantly becomes electrical. The end nearest the earth will be plus electrical and the upper end minus. If the rod be held near the ground, and then raised as high as a man can reach, the electrometer indicates a change of electrical condition; when near the ground, it is most electrified. The electrometer at the Smithsonian Institute

* That conclusion fastened itself on me during my observations in thunderstorms during balloon voyages.

showed great changes in a few feet elevation. It had been demonstrated that the electricity was repelled by the atoms of matter composing the earth into the air. He used the word repelled as best expressing the idea. It had also been demonstrated that an atom of electricity at the surface of the globe acted in concert with the globe itself in repelling a second atom of electricity outside the first. The repelling power was inversely as the square of the distance. Professor Henry then gave the phenomena of explosive atmospheric electricity. No thunder-storm can occur until there are two layers of clouds. The electricity is carried into the air by the masses of vapor going up from the earth. Vapor rising from the earth always carries more or less electricity with it. He had ascertained these and other interesting facts from Mr. Wise, the balloonist, with whom he had been in correspondence, and who had undertaken experiments. Mr. Wise said that in passing through a thunder-storm he was always first carried through a dense cloud into an open space, with a second cloud hanging above him. Currents of air frequently moved transversely to the current below the lower cloud. He had repeatedly been carried along by this transverse current; and upon coming down through the lower cloud, he had been caught by the ascending current and whirled up again. Between the two clouds there were constant flashes of lightning from the upper to the lower. These flashes were not explosive. The heat lightning so often seen is the electricity of the upper cloud descending to the lower. The explosive discharges are generally between the lower cloud and the earth. Between the two clouds hail is formed. The upper cloud is always less dense than the lower,* and always less electrical.

"A thunder-storm as it moved across the country was sometimes constantly renewed by the masses of vapor constantly ascending and carrying up electricity from the earth in diffused particles, to be returned in explosive discharges. New vapor carried up new electricity.† The French physicists thought that a thunder-cloud might be disarmed by running up numerous points. It might be disarmed or rendered harmless for a single locality, but as the clouds passed on, new electricity would be sent up, so that to wholly disarm the thunder was impossible, for it had new resources always at command.

"Mr. Wise had seen a water-spout on one occasion that had no upper cloud, but was, in the beginning, a single cloud of great density, which began to hang down in the centre like a funnel, hollowed into a whirlpool, carried round with tremendous rapidity, with discharges of lightning across it, and explosive discharges to the earth. Mr. Wise had invited him to a balloon excursion into a thunder-storm."

In July, 1859, the author of this work addressed the following letter to the *Scientific American*, of New York, to wit: "In No. 1, Vol.

* It looks so, being much lighter.

† I always found that to be the case as the storm crossed forests and moved along valleys.

I., new series, there appears an article under the head of 'Lightning batteries—remarkable invention,' stating that M. Hippolete Charles Vion, of Paris, France, has invented and patented certain contrivances for bringing down from the atmosphere natural electricity, to be used as a motive-power for various purposes, and that in level countries it is to be brought down with a balloon and conducting wire. As I claim priority of design, if not of doing the thing satisfactorily—although I have brought down electricity with a six feet diameter balloon and hempen cord—permit me to say how far my claim stands the proof of record.

"In the fall of 1857, I wrote to Prof. Henry, secretary of the Smithsonian Institution, about it, and my wish of having it tried with a large balloon that would go a mile or two high, with metallic tractors and conducting wire to bring it down to the earth. September 26, 1857, Prof. Henry answered me. He says: 'It is a fact, established by abundant experiment and observation, that the difference of electrical intensity between the surface of the earth and the atmosphere increases as we ascend in the latter. If we were to suspend a copper wire to a balloon, the lower end of which is insulated at the surface of the earth, the quantity and intensity of the electricity which would be given off from the lower extremity of the wire would increase with the elevation of the balloon, though the law of the increase with the elevation is not yet known. I doubt whether a sufficient quantity of electricity for practical purposes could be obtained in the way you propose. The electricity of the atmosphere, though greater in intensity, is very small in quantity, according to the experiments of Faraday, Pouillet and others. I would not wish, however, to discourage your experiments. It would give me much pleasure to see you in Washington, and to have a long talk on the subject of atmospheric phenomena,' etc., etc.

"In April, 1858, I made my visit to Washington accordingly. I spent several days with Prof. Henry; and after stating to him all I knew about thunder-storms and atmospheric phenomena, so far as I had observed and experienced the workings of nature, both in and outside of the clouds, I proposed to build a balloon expressly for these experiments, to be conducted under the auspices of this learned philosopher, the Smithsonian Institution to furnish gas, conductors, ropes and meteorological instruments. To this the secretary at once agreed. The balloon was built and arrangements were instituted to make the experiments in August or September of 1858. Business, however, pressed so hard on him about that time, in bringing out his 'Report' of the transactions under his charge, that it was necessary to defer these experiments until the next year.

"In May, 1859, I made an ascension with this balloon. It was labeled, or rather named, 'Smithsonian,' and bore the motto, *Pro scientia et arte*. Having noted some remarkable phenomena during this voyage, such as an incipient thunder-cloud, the formation of a waterspout hanging down from this cloud, the increase of the cloud into a

regular thunder-gust, and while sailing in the trail of the storm—that is, in the rear of its ascending vortex—encountering large drops of rain dashing against the balloon and scintillating fire as they struck the balloon, it is needless to say I hurried down upon that demonstration. The ascension was publicly made from the Centre Square of Lancaster City, Pa. In the acknowledgment of this report to him, Prof. Henry said:

"'I have read with great interest the account of your aërial voyage from Lancaster, and write to thank you for the pleasure and information it has afforded me. The fact of the luminous appearance of the drops of rain, of the comparative less velocity of the storm than the balloon, the want of an apparent upward motion, as in the case of a thunder-storm, are all highly important in a scientific point of view; and in order to preserve them in a more accessible condition, I shall publish your letter in the next report of the Smithsonian Institution.

"'Did the water-spouts you describe descend to the earth and produce their usual destructive effects? Please to inform me as to this, and give me any other facts of interest which may occur to you in regard to the weather and the condition of the atmosphere at the time.

"'Was the day sultry? Was the sky clear or covered with clouds? Did the rain appear to fall through the "udder," or was it thrown out to a distance, so as to fall through a circular space of which the trunk or udder was the centre?

"'The upper surface of the clouds was probably above you in point of vision, whether or not it bulged above the point from which the trunk protruded below.

"'I shall probably have a few weeks' vacation this summer, and would be pleased to make some of the experiments with you, which we contemplated last summer. Please inform me when it would be most convenient for you to meet me.'

"When I received this cheering proposition from Prof. Henry to make the experiment of bringing down atmospheric electricity with a view to its uses as a motor, I was busily engaged in making preparations for the great trans-continental balloon voyage from St. Louis to the Atlantic seaboard with the balloon 'Atlantic.' Business matters of the institution continually pressing upon Professor Henry, and the rebellion already developing itself like an incipient thunder-storm, was the cause of not making the experiment, and it was almost forgotten.

"This is sufficient to show that America has the first claim to the practical idea of appropriating natural electricity as a motor for engines. A natural power capable of pulverizing rocks, splitting up trees, knocking down masonry and ploughing up the earth wants only to be properly understood and properly harnessed to make it subservient to human purposes.

"In June of 1859, Prof. Henry, while speaking of meteorology, at the Springfield meeting of the 'American Scientific Association,' said

in his discourse that 'he had conferred with Mr. Wise, and thought that the success of the proposition to cross the Atlantic Ocean in a balloon was by no means improbable. And I look upon the balloon as a very important instrument in meteorology, and the observations of Mr. Wise have been of great value.'"

I make this digression from the present subject merely to show what the best authority on these matters thinks of my observations concerning them. And it will not be considered an inexcusable digression to state a circumstance showing how abstract science sometimes points out the places, modes and forms of things in advance of their realization. While Prof. Henry and myself were talking over the matter of thunder-storms, Prof. Espy, then acting as meteorologist for the United States government, came into the room, upon which Henry asked him whether thunder-storms had any peculiar shape, to which Espy replied, "Certainly they have, or ought to have;" then pointing to me, said, "Wise ought to know that." Upon being requested to pencil a sketch of the shape of a thunder-storm on a sheet of paper, he drew precisely the same figure I had drawn the evening before as an illustration of the geometrical figure a storm presents to the eye of the aëronaut when sailing past its side. Prof. Espy took a great interest in my balloon observations. The following letter was addressed to me by him in relation to the ascension from Carlisle in 1843, the particulars of which are given in a previous chapter:

"Washington City, July 5, 1843.

"Dear Sir: I was much interested with the account you gave in the public papers of your balloon ascension on the 7th of last March from Carlisle.

"You will confer a great favor on me if you will answer the following questions: Was there any rain or hail at the surface of the earth under the clouds which you entered? Did you descend through the base or lower part of the cloud, or did you get out of the cloud and descend in the clear air? Was the cloud into which you ascended surrounded by clear sky, or was the whole sky covered with clouds? Have you any reason to think there was an upmoving current of air going up into the base of the cloud and continuing in the cloud itself, or did the velocity of your upward motion merely correspond with the buoyancy of the balloon? What was the cause of your ascending and descending eight or ten times? Had you a barometer? Do you suppose the cloud was colder than it was at the outside of the cloud at the same height, or not so cold? Are you sure your balloon was torn by the hail? or might you not have ascended much higher by a very rapid motion than you had supposed, and your gas have escaped by expansion through the bottom of the balloon? If there was a strong current of air under the cloud and in the cloud upward, might you not in the time have gone so high as to diminish the pressure on your body so rapidly that part of the noise which you heard was the ring-

ing of your ears? And might not the sickness have been from the same cause?

"If you find time to answer any of these questions, I will be much obliged to you. Yours, very respectfully,

"JAMES P. ESPY.

"JOHN WISE, ESQ., Aëronaut."

Like the beautiful and exact arch of the rainbow as it spans its prismatic colors athwart the heavens, so has everything in nature its shapes, and its forms, and its ways of working, with an exactitude that is unmistakable, and in every blade and flower, the surging of the ocean, the rumbling of the earthquake, the motion and track of the planet, we have proclaimed throughout the universe that an intelligent Power and divine Providence directs and rules the heavens and the earth.

The phenomenon of silent lightning is one that has puzzled the researches of physicists. Some meteorologists contend that there is no such thing as "still lightning"—that it is the distance from the observer that causes the absence of its sound. One night I watched it for an hour, and it was then flapping in the distance and immediately overhead. The tops of the nimbus clouds were at times brightly illuminated. Most of the time the flashes were feeble, but in very rapid succession. The day had been sultry and hot, and this is always the case when still lightning plays among the clouds. Only once in thirty years did I observe this phenomenon in daytime. It flashed between the upper and lower cloud of a thunder-storm, and involved the whole aërial apparatus, but there was neither sound nor shock. It was of an orange color, resembling somewhat, both in color and tremulous action, the aurora borealis. It might properly be denominated electricity of feeble tension. Judging its nature and development from its appearances, it seems to go upward more than downward, and it would seem from this to pass from the earth to the clouds.

I had in my experience one natural illustration of its real character. It occurred during the great balloon voyage from St. Louis, Mo., to Jefferson county, N. Y. The balloon was inflated on the first day of July, 1859, the day being very hot, and at 7 P. M. the balloon ascended. It was new moon, and at 9 P. M. we had nothing but starlight. My attention was now drawn to the illuminated appearance of the balloon. Every seam and every little mark upon it was made visible from its translucent character. It was filled with a pale, orange-colored light, enabling me to see the hour and minute hands of my watch, as well as to see the figures on the barometer. We carried this enveloped light all night. Being of feeble tension, it died away in appearance at the dawn of the morning. During the night I saw in the distant clouds—we passed *through* none that whole night—a flickering of silent electricity. After a while this changed into a thunder-storm, in which thunder and lightning were discernible in the distance. This is gen-

erally the case after the appearance of silent lightning, though not always. Sometimes simple showers follow the phenomenon of still lightning.

Now, in the case of the phosphorescent matter carried along in the balloon, it would seem to have been taken from the earth—the heated earth, as the day was excessively hot; and having the same affinity for the hydrogen in the balloon that the still lightning has for the clouds, it developed itself in a similar manner—that is to say, by feeble illumination.

In my late observations on still lightning, it seems to me to be explainable in this way. When the weather is calm and the sun shining hot all day upon the earth, its surface becomes overheated. This causes a sultry atmosphere, and after the setting of the sun this atmosphere becomes very humid, causing a lassitude of the animal system well known to every intelligent person. Humid air, being a slow conducting medium of electricity, conveys it up to the incipiently formed scattered clouds, where, by its feeble tension and diffuse condition, it flickers in the clouds and darts from one to the other, as they stand related by their positive and negative conditions.

The lassitude we experience on these occasions arises from the loss of animal electricity—the vital force that strings our nervous system and gives us power to live, and move, and work, and think.

It might properly be termed electricity of slow velocity, in distinction from electricity of high velocity. The one kind might be compared to gunpowder spread out over a large surface and scattered, which, when fired, would be slow in motion; the other to gunpowder compressed within a small compass, which, when fired, would be quick in motion. From this view of the matter, subject as it must be to various modifications arising from the various degrees of condition in these atmospheric phenomena, we have a clue to the upward stroke of lightning, visible and invisible thunderbolts. It is only by close scrutiny and persevering observation that electrical phenomena are becoming reduced to scientific data. There are some authenticated accounts of persons being shocked, knocked over and convulsed by upward strokes, in which there were no electrical explosions, as in the case of thunderbolts, but all these cases are shrouded in mystery so far as a knowledge of their scientific causes is concerned. That silent lightning plays a different part from that of explosive lightning is clearly evident.

Such is also the case with fire, combustion. We have fire that burns the hand when touched, and we have fire that may be touched with impunity. *Eremacausis* is the term for this innocent kind of fire. It is the technical word for slow combustion, such as we find in rotten wood, known as "fire wood," in the firefly, rotten fish, etc. Chemistry teaches us that *eremacausis* is nothing different from that of the firebrand under the dinner-pot, except in degree. One is slow or feeble combustion, the other is violent or intense combustion. Such would

seem to me, as far as close observation teaches, to be the difference between silent lightning and explosive lightning; and in both cases of comparison, the feeble or inactive may merge into the violent or intense condition. Spontaneous combustion is nothing more than a change from slow into quick combustion. Oiled rags possess this chemical characteristic, but nevertheless subject in their action as to rapidly or slowly, merging from incipient into mature combustion, as the author has good reason to know, by certain atmospheric changes.

A sudden change of atmosphere from dampness into that of clear dry weather—as, for instance, the change from south-easterly winds to north-westerly winds, such as make the electrical machine snap and crack with a vigor well known to electricians—is peculiarly favorable to spontaneous combustion of oiled textile fabrics. It has been the cause of many mysterious conflagrations, especially where lamp wipers and machinery cleansing-rags or cotton waste have been thrown into a heap of rubbish.

The celebrated Duhamel du Monceau states that this silent lightning breaks ears of corn on the stock, and that farmers are well acquainted with this fact. He says, on the 3d of September, 1771, there was much lightning in the morning, and that he found nearly all the ears of corn in his field broken off at the nearest knot. The only ears which remained standing were the green ones. There are a great many instances of this kind recorded, such as the barking of trees during thunder-storms, supposed to be the effect of silent lightning.

The Abbé Ricaud says: "On the 2d of July, 1750, at three o'clock in the afternoon, being in the church of St. Michael, at Dijon, during a storm, I saw appear suddenly, between the first two pillars of the principal nave, a red flame, which was suspended in the air at the height of three feet from the floor. This flame then gradually augmented its volume until it finally attained the height of from twelve to fifteen feet. After having risen through several fathoms in a diagonal direction nearly to the height of the organ gallery, it disappeared with an explosion resembling the report of a cannon discharged in the church."

We find another instance of electrical luminosity among the many that might be recorded of still lightning, in the report of Major Sabine and Captain James Ross, in their first north pole expedition while in the Greenland seas. During one of the dark nights of those regions they were called up by the officer of the deck to observe a very extraordinary phenomenon. Ahead of the vessel, right in the course then steering, there appeared a stationary light, resting on the water and rising to a considerable height, while every other part of the heavens all around the ship was as dark as pitch. As these navigators knew no danger likely to result from such phenomena, the course of the vessel was not altered. When the ship entered the region of this light, the vessel became illuminated, so that the minutest parts of the rigging became visible. The extent of this luminous space was about

four hundred and fifty yards; and when the ship emerged from it, it seemed suddenly to have been plunged into thick darkness. Behind there remained this luminous spot quite stationary. These gentlemen communicated this fact to M. Arago. He simply replied, "The cause of these phenomena, to use the beautiful expression of Pliny, is still hidden in the majesty of nature."

Still lightning, ball lightning, and, we might say, spear lightning, were all known even to the ancients, and long before electricity had taken its place among the sciences. The points of spears of the ancient soldiers were frequently illuminated by electricity, and sometimes a great battle was lost to the party who had the misfortune to be the recipients of this phenomenon, because the soldiers looked upon it as an evil omen, and thus considered themselves only marching to a forlorn hope. When these ball lightnings flickered in pairs at the ends of the ship's yard-arms, the sailors called them "Castor" and "Pollux;" when single, they called it "Helen." The latter was deemed an evil omen, the former a favorable presage.

It is frequently said that there are strokes of lightning from the earth to the clouds. As regards forked lightning, such as we term thunderbolts or zigzag lightning, there are no well-attested cases reported in the authorities on this subject. But it would appear that there is a class of phenomena of lightning effects, such as persons being shocked and struck and charged, that would indicate that electricity at times proceeds from the earth toward the clouds.

In the neighborhood of Cold Stream, on the 10th of July, 1785, a storm broke out about noon, and Brydone, being on the ground, relates the following circumstance: A woman who was cutting grass on the banks of the Tweed was suddenly thrown down without any apparent cause. She called her companions to her, and stated to them that she had received a sudden and violent blow on the soles of her feet, but whence it came she could not tell, as there was no thunder and lightning at the time. At the same time a shepherd saw one of his sheep fall suddenly down, and on examination found it stiff and dead. At this time a storm was approaching in the distance. Two coal-wagons driven by boys who were seated on the benches had just crossed the Tweed, and were in the act of ascending the opposite bank, when a loud explosion was heard, but unattended by rolling thunder. At the moment of the explosion the boy who drove the hinder wagon saw the foremost one, with the two horses and driver, fall suddenly to the ground, the coal scattered around in every direction. The horses and driver were instantly killed. The coal had the appearance of having been in the fire. The points where the wheels rested on the ground were found to be pierced with circular holes, which Brydone says emitted an odor resembling ether. The hair on the legs and bellies of the horses was signed, and from their appearance as they lay it was evident that they were struck suddenly dead, so that no life remained when they touched the ground. The body of the driver was scorched

and his clothes were reduced to rags. A strong odor proceeded from them.

All the witnesses of this disaster agreed that no luminous appearance attended its occurrence. A sound was heard, but no light was seen. This seems to have been one of the rare classes of electrical phenomena passing from the earth toward the clouds.

From all the observations by the writer, it would seem to him as a logical proposition that the earth is endowed with a normal portion of electricity, rendering it positive in relation to the air above it; that an accumulation of heat on any given space of the earth's surface will cause an uprising vortex of air, carrying with it the electricity of this space, which is liberated suddenly by the condensation of the vapor carried from the surface of the earth to the higher and colder portions of the atmosphere, thus rendering these suddenly-formed thunder-clouds positive as related to the earth below them. In this view of the case, we may have, as it seems we do have, reciprocations of positive and negative electricities between the earth's surface and the cloud surface. When the sky is clear, it must be negative as related to the earth. In such case the phenomenon of still lightning, ball lightning and aurora borealis would be natural results. Upward strokes would also ensue, as in the case of the woman struck in the soles of her feet, she forming the conductor between the positively charged earth and the negatively charged cloud above.

I have on several occasions been the subject of the electrical phenomena in my own person. While combing my hair on one occasion with an India-rubber comb, sparks and brushes of fire were emitted; this continued for several hours, whenever the comb was run through my hair. At another time the tips of my fingers emitted a bright light upon touching the plaster of the walls of the house. When I would draw my fingers down the wall, streaks of fire would shine in their track. At another time, in going to a wardrobe where a black silk dress was hanging, the dress emitted flashes of fire on being shaken. And at another time, coming home late at might in frosty weather, I threw my blue cloth cloak on a highly polished mahogany table, when it emitted a copious flash of fire. I repeated it, and found each successive time the flash grew weaker. I have also seen coruscations of electricity playing around the safety-valve of a locomotive engine on the Cumberland Valley Railroad. There was steam escaping from the valve at the time. The engineer, Mr. Cockley, who drew my attention to it, informed me it always happened so when a thunder-gust was pending in the neighborhood.

## CHAPTER LIV.

Effects of lightning—Lightning conductors—Lightning-rods.

THE housewife has a tradition that the breakfast milk is curdled from the effects of the thunder and lightning of the night previous. Many electricians looked upon these notions of milk curdling suddenly, bread in a state of ferment souring, eggs in the process of incubation being rendered inert, etc., arising from electricity, as being too absurd for scientific consideration, looking upon it with the indifference and contempt that the Royal Society did upon Franklin's idea of drawing lightning from the clouds with a kite. Modern discoveries, however, verify the humble family tradition. It is now well ascertained that electricity generates ozone. This ozone gives rise to the sulphurous smell we perceive in places where thunderbolts have struck. The same smell is perceptible when we knock two flint-stones together, and when we rub a glass tube to excite positive electricity, or as it develops itself at the rubber of an electrical machine when put in motion.

Ozone is air holding a double portion of oxygen in its composition. It is called "alotropic condition of the atmosphere." The author has often smelled it when passing through clouds, and has at times been made hoarse as a pond-frog by inhaling it. It is this powerful acidifying agent that causes sourness of milk, etc., during thunder-storms.

For a long time physicists supposed that there was such a thing as cold strokes of electricity. Franklin adopted this theory, even to the belief of the cold fusion of metals, endeavoring in this way to account for some anomalous freaks of lightning. The march of science soon dissipated these erroneous notions, showing that lightning may strike metals and melt them, and at other times strike metals and not melt them. In the former case the electric fluid is arrested, and thus spends its force upon the metal, causing it to heat, weld, fuse, and sometimes vaporize. In the latter the metal escapes this heating power by having a line of conduction to the fluid, and thus spreads, dissipates and equalizes it over the surface of the adjacent earth.

The power of lightning to fuse metals was known to the ancients. Pliny, Aristotle, Seneca and others speak of it. Seneca says that the coin in a purse was fused, while the purse was not injured in the least, and that a sword was melted in its scabbard without touching the

sheath. Pliny gives an instance where a bag of silver and copper money that was sealed up was melted by lightning, and the bag was unburnt and the sealing wax unmelted. From such facts Franklin deduced the doctrine of cold fusion, believing that metals could be liquefied without heat. And to this day you may hear persons relating circumstances of cold strokes of lightning. There is no such thing as fusion of metals without heat.

Lightning welds metals as well as fuses them. On the 20th of April, 1807, a windmill was struck by lightning in Lancashire; the fluid ran down a chain used as an elevator, heating and softening the chain to such a degree that its own weight caused the welding of the links into one rigid bar of iron. Such instances could be multiplied without number, as recorded in the works on this subject.

Lightning also melts the sand where the thunderbolt descends from the clouds to the sandy plain beneath. Such vitrefactions are termed *fulgurites.* They are hollow conical tubes, inside coated, or enamelled, with a smooth coating of glass hard enough to strike fire with a flint. The finding of these curiosities gave rise to the belief of the thunder-stone; and at the present day many persons believe the thunderbolt to be a missile of this character, mistaking the effect for the cause.

Some years ago the house of Alexander Danner, in the city of Lancaster, was struck by lightning. In company with Franklin Reigart, the author made an examination of the premises. The house was a one-story brick building with shingle roof. In the roof there was a sheet of tin, having been put there to replace a decayed shingle. Immediately in front of the house, upon the curb line, stood a buttonwood tree, towering above the house. The bolt struck into the top of this tree, ran down one of the two main branches of it to the crotch below, from whence it glanced off, and right across the pavement on to the sheet of tin above mentioned, knocking a hole of an inch in diameter through the tin, and leaving scars on the crotch of the tree. From the tin it darted back some distance to the tin water-trough at the eave of the roof; from this point it ran right and left, leaving at various places on the tin water-trough holes one-tenth of an inch in diameter. At the left termination of the water-trough it darted on to the wooden cornice, and shivered it, also knocking out several bricks from the wall under the cornice. At the other end of the water-trough it descended the water conductor to its end, about two feet from the water-pan in the pavement; from the end of the water conductor it darted on the water-pan, turning it upside down and burrowing a hole in the ground immediately under the spot the pan occupied much like a hole made by a post-hole auger.

Many curious theories have been propounded in explanation of the effects of lightning in its anomalous freaks of action upon matter struck by it. Its force will pulverize stones, disintegrate trees, perforate metal plates, melt the most refractory metals, evaporate gold and silver, kill animals, etc. The most rational conclusion we can arrive at as regards

the mode of its mechanical effects is that it obeys the same dynamic laws of all other matter and forces. It glances like a cannon-ball, flies off at a tangent, rebounds, follows the course of least resistance—indeed, it seems to obey all the behests of other moving bodies, and varies only from others in that its velocity is superior to any other mundane moving bodies.

That some substances are better conductors of lightning than others is well attested in the course that it pursues when liberated. It will break through solid bodies of wood and stone to get to a body of metal; and we may safely lay down the rule that from the best conductors, such as charcoal, metals, wet earth, water and fires, to the best non-conductors, such as glass, silk, feathers, dry wood, etc., there is a regular gradation of electrical attraction. When lightning follows a conductor of any kind, and such conductor comes to an abrupt end, an explosion invariably takes place.

Lightning struck the rod of Mr. West's house, in Philadelphia, and at the place where its lower extremity entered the dry ground, about five feet below the surface, an explosion took place. The pavement in the vicinity being wet, it gave it the appearance of being on fire, the flame covering it for several yards.

An instance is related of lightning striking the steeple of St. Bride's Church, in London, doing great damage. The weather-cock was first struck; from that the bolt descended along a bar of iron buried among the massive stones of which the steeple was built. This bar was two inches thick and twenty feet long, its lower end terminating in a cavity in a stone five inches deep, secured by lead. The gilding on the cross and weather-cock was nearly all destroyed; what remained was blackened. The soldering was fused. Along the bar which it descended it left no visible trace, but at its lower extremity, where the continuity ended, the marks of violence were visible. The stone was shattered to pieces, and at this point a large breach was made in the wall of the steeple. From this point the bolt leaped from one iron clamp to the other immediately under it, and so on to the next proximate one binding the large stones together in the masonry, splitting and pulverizing some, and hurling others from their places, leaving general destruction in its track.

Some modern philosophers contend that there is no such thing as an electric fluid, but that it is the motion of the ultimate particles of matter. This idea is not reconcilable with the effects of the thunderbolt, unless we allow in this theory that the ultimate atoms of matter fly from their gravitating centres. If it were the ultimate atoms of iron composing a bar that became welding hot by the action of lightning, there must have been something to put these atoms into corpuscular action. True it is that some electrical phenomena develop themselves in such a way as to apparently put all known laws at defiance. But does this not arise from the fact that we are not perfected in the understanding of natural laws? In another century they may be as

comprehensible as are at present the laws that spring from atmospheric pressure.

Before the invention of the barometer the law of the suction-pump was a mystery. The explanation was that nature abhors a vacuum. But says an astute philosopher of that day, "It abhors a vacuum only to the extent of thirty-four feet." So with the often anomalous play of electricity. It acts only in some cases beyond our ability to trace its peculiar characteristics.

A volume might be written to illustrate the freaks of lightning, and many, no doubt, will yet occur before mankind shall have as good an understanding of its nature and habitudes as we have of some other physical sciences. When we shall become more acquainted with the nature and laws of electricity, we will no doubt be enabled to avoid many of the ills and ailments from which we suffer. Already electropathy is adopted in the healing art, but it is the blind leading the blind as yet, for, like a two-edged sword, it cuts both ways, and requires to be better understood before it can be reliably applied in the profession of the healing art.

Having noticed some of the well-authenticated facts of the effects of electricity, let us now turn our attention to lightning-rods, and investigate the nature and facts of their utility, and their protection in shielding our houses and other buildings from the destructive power of lightning. Many persons contend that lightning-rods are of no use whatever. Some go so far as to say they are a positive injury, subjecting the buildings they surmount to continual danger of being struck by lightning, acting as tractors to the descending thunderbolt, and very often causing the destruction they were intended to avert. A great many buildings have been struck with lightning, and burned to the ground, upon which the lightning-rod had peered, and drew, as it were, the descending bolt to its metallic surface, when it would otherwise have taken a different direction. Whatever the merits of the lightning-rod may be, it was never designed to be struck. That would be like averting the effects of a cannon-shot by attempting to catch the ball on the point of a bayonet. Jugglers perform this feat, but sensible people look upon it as a trick. The efficient way of averting the cannon-shot is to draw the charge silently, or else plug up the touch-hole with a rat-tail file.

If we attempt to draw a comparison for or against the rod by the number of buildings struck by thunderbolts and burned or shattered by its effects which had lightning-rods on them, and the number struck that had no rods on them, it tells a tale against the lightning-rod.

In searching the records of ancient times, before the invention of the lightning-rod, to ascertain the comparative amount of injury done by thunderbolts, and comparing with the injury done from the same cause since its invention, we shall again be confronted with the fact that in these later days the vengeance of Jupiter is more potent and more frequent than it was when the bell-ringers used to scare him off

with the clamor of the church bells. Like the weather and the moon in fifty years' comparison of the fulfilment and non-fulfilment of the predictions of the weather by the signs of the moon, the moon loses its glory by a decided majority against it. With meteorologists the moon theory of weather prediction is a dead letter, and yet all this time the farmer consults his almanac to ascertain the upgoing and downgoing of the moon in order to make a good deposit in seed-time. The housewife, not to be behind the times, looks to the almanac prediction for clear weather in order to have a good time for general washing-day. And so it is with the lightning-rod. When the house is built, and the outside and inside completed and finished in detail, the proprietor feels like putting the finishing stroke to it in the erection of the lightning-rod, and very often it does finish the edifice.

The vineyards of France being very subject to destruction from hailstorms, their owners adopted some years ago their system of paragreles, being nothing more than little lightning-rods erected on bean poles, believing that they would equalize the electricity of the clouds with that of the earth, and by that intervention prevent these destructive hailstorms. They found, however, that, despite of the paragreles, the hailstorm destruction continued. Upon this, the philosopher Arago suggested that these conductors, or rods, be raised to a great elevation by balloons. While it was conceded that Arago's method would remedy the evil, it never got into use, because of its expensiveness. Here, then, we have one of the first philosophers in the world maintaining the doctrine that in order to make the lightning-rod efficient in disarming the surcharged cloud of its hail-forming power, the point of the rod should penetrate the very magazine of thunder and lightning.

The thunderbolt has ever been viewed as pending over our person or property in the same light that we would view a cannon loaded with powder and ball poised and trained directly upon us, ready to be fired by accident or incident, as the case might be, wanting only the spark at the touch-hole. What would be our remedy in such case to avert the pending danger? The cannon is too heavy to be removed. Then it must be disarmed. The charge must be drawn. How? Certainly not on us. So reasoned Franklin. How, then, is it to be drawn? Why, silently. Drawn with the screw-ramrod, as the gunner draws it from the cannon, when he does not want to fire it upon anybody. How is this to be done in the case of the cloud poised five to seven hundred yards above us? Why, as Arago says: point your paragreles into the clouds, and draw the surcharge of the positive cloud into the negative earth, and thus restore the electrical equilibrium between the two surfaces, that of the cloud and that of the earth in juxtaposition.

Will not the ordinary lightning-rod do this? That is the question. When the thunder-clouds run low enough to scrape the tops of our buildings, the rods surmounting them will draw off the electricity silently; they will even be pointed with a minute blue flame while doing this. Such conditions of thunder-storms are of rare occurrence.

They are the exceptions to the rule. But, says Franklin, will not this take place by induction? And so say, or rather ask, many electricians. The author maintains it will not. It can not by induction through a space of one or two thousand feet disarm the surcharge cloud. Induction acts only in proximate series.

On a succession of clouds, one close above the other, piled up as it were from earth to heaven, it would act to disarm, and that silently, by induction. The side of the cloud nearest the rod would be negatived by giving up to the rod its surcharge. This would render the other, rather the upper side, negative, and the negative side of this would, in its turn, render the proximate side of the cloud next above it positive, causing it to give up its surcharge to its negative neighbor below, just as the lowest cloud gives it up to the lightning-rod. This is a very pretty theory as to thunder-clouds, but an untenable one as to the vacant space between the earth and the thunder-cloud in ordinary thunder-storms.

The advocates of the induction theory fail to establish this when they admit that air is a non-conductor. If the clear space between the earth and the cloud would conform itself into this condition—*i. e.*, arrange itself into series of electrical strata—we should never see the bolt come crashing through it, taking the rod for a target in its course, in case the bolt happens to come near to it in its downward course to the earth. The bolt striking the rod is fortuitous, inasmuch as the rod is near its line of direction, and metal, being more tractive to electricity than wood or mineral, air or earth, passes the fluid onward. As the induction theory fails to meet the case in matter of fact, as well as in matter of strict electrical science, it remains to be proved that the rod acts as a preventative of harm from thunderbolts. If the ratio of buildings destroyed and damaged by lightning which had rods on them did not hold equal—at least equal—pace with the number destroyed or damaged which were without rods, the question might rest here. But as before mentioned, it tells a tale against the rod, and thus science attempts to suggest a mode for the erection of lightning-rods that will shield our property from the descending bolt. The ordinary rod will not accomplish this. Its lower extremity, buried five or six feet in the earth, will not enable it to diffuse the electric fluid into the earth, but will, on the other hand, cause it, by recoil, to leave the rod and dart upon the next best proximate conductor, and this is often the human body. Very often, in such cases, the metallic jewelry worn about the person is melted or partly fused. In other cases the recoil electricity, darting and flashing from the rod, scintillates upon the straw thatch of the barn, on the furze of old shingles or some other proximate combustible, setting it on fire. Although the thunderbolt seems to play, in numerous observed cases, very contrary and anomalous parts, a strict investigation always shows that it invariably obeys the known dynamic laws of motion which govern all moving bodies.

The seeming exception to these laws arises from its greater velocity;

what it lacks in solidity of body it more than makes up in superior velocity. It is now adopted as sound philosophy that motion and heat are convertible terms, that a solid body may, by a high velocity, be converted into thin vapor—dissolved into its elements, into heat.

The revelations of the spectroscope in observations upon the sun indicate the absence of oxygen in that body; and as our terrestrial chemical philosophy teaches us that there can be no combustion without oxygen gas, it follows that there must be some other way of decomposition of the materials that keep up the heat and power of that body than by the aid of that gas. Hence the theory of velocity—that is to say, the inconceivable motion or the gravitating rapidity with which meteors, comets and worlds rush into the body of the sun, being by such great speed, say two hundred thousand miles in a second, converted into gas, accounts for the heat of that luminary, which is continually dispensing to its family of subordinate planets heat and light. Such velocity modern philosophy assigns to the thunderbolt as its *vis inertia.*

A cannon-ball of one hundred pounds' weight, moving at the rate of eight miles per minute (the average velocity of cannon-balls), would not exert as much force in striking anything as would a buckshot moving with the velocity of a thunderbolt. Hence it takes but a very small quantity of lightning to knock the life out of a man or a beast. The riving of trees, the pulverizing of massive stones, the forming of fulgurites, the melting of metals, and the many other wondrous feats that lightning performs, are not so strange when we take into consideration the great velocity with which it moves. What the substance is we know not, and in the words of Pliny we can only say it lies concealed within the majesty of nature.

The attempt to arrest or to negate the violence of the thunderbolt, darting from the clouds to the earth, is futile. The lightning-rod that intercepts its path shares the same fate that any similar substance shares in being struck: it is twisted, wrenched from its fastenings, melted into drops, and only tells the tale that the rod was struck, instead of something else. How often do we see the effects of lightning where no rod is near, with nothing more than a rail or post split in pieces, a stone crushed to powder, a chain of iron fused into a solid bar; all these freaks accomplished by a very small quantity of matter coming with a very great velocity. The fires that it kindles and the lives that it destroys are what give it its terrors, together with the roaring of the thunder that accompanies it. And yet, with all this terrible array of its powers of destruction, the damage of property and loss of life from it are not a drop in the bucket compared with the destruction of property and loss of life caused by steam-boiler explosions.

The lightning-rod as used for the protection of ships at sea is the most perfect rod in use, and when terminating in contact with a ship's bottom that is coppered ought to be never-failing, if the theory of the

lightning-rod is correct. The author is not certain that ships' rods are so terminated. They run from the mast-head down and over the side of the ship into the water, and ought to connect with the copper on its bottom. Nevertheless, ships are struck with thunderbolts while at sea, sometimes shattered, at others burned up, having rods on them, just as ships are without them.

To say that a lightning-rod was struck upon a house, and that the house received no serious damage, proves nothing more than does the house that was struck having no rod on it and suffered no serious damage. We could multiply such instances of rod and no rod immunity from thunderbolts. It is a fact patent to all observers of lightning phenomena. As long as the thunderbolt exhibits its partiality to buildings with rods as generously as it does to buildings without them, the philosophy of lightning-rod protection fails to establish its peculiar claim, and more especially so when we take into consideration the other view of the case, wherein buildings with rods peering on them are burned down as well as buildings without them. Even in the ship's rod we have this anomaly. The foremast of the ship Endymion was struck by a bolt at Calcutta in March, 1842. The mainmast, not fifty feet distant, had on it a lightning-rod which failed to perform its office. Again, the bow of the ship Etna was struck at Corfu, January, 1830, although the mainmast carried a lightning-rod. Many instances of this kind are noted of buildings on land, notwithstanding electrical authority puts down the rule that the area protected is equal to four times the diameter of the distance from the point of the rod to the plane where it enters the earth. Thus, if the point of the rod is one hundred feet above the ground, a space of four hundred feet in diameter comes under its protection. So said the Physical Section of the Academy of Sciences at Paris. Experience and the thunderbolt have long ago proven this as erroneous as is the prediction of the weather by the old-fashioned Dutch almanac.

The thunderbolt generally darts upon the highest points, but not always so; sometimes it takes the middle of the height. There are instances recorded where persons in the upper story of a building were struck dead by a thunderbolt, while persons in the story below were unharmed.

The cathedral of Milan was struck by a thunderbolt, also the lighthouse at Genoa, both damaged, and both surmounted by lightning-rods of the most approved construction. These many contradictions of the theory and utility of the lightning-rod have caused many people to discard them altogether, while others cling to the belief of their utility, as do the believers in the upgoing and downgoing of the moon in reference to seed-time and harvest.

It is not the intention of the author to make out a case for or against the lightning-rod, but to give facts as they occur, and allow the intelligent observer to draw his own conclusions. The subject has puzzled philosophers from the days of Pliny down to the present, and we must

be content with the facts revealed by nature, noting them from time to time, because as yet the science of the lightning-rod is as vague and undefined as is the science of the "nebular hypothesis."

It is considered dangerous to erect lightning-rods on powder-magazines. The sparks scintillated from a thunderbolt, it is said, might ignite some powder accidentally lodged in some projection or crevice of the building. Consequently, it has been proposed to erect the rods away from such buildings, or, as suggested by Dr. Lardner, to have a number of rods placed around the building some distance away from it.

In defence of the rod, M. Arago states that the temple of Jerusalem stood from the time of Solomon till the year 70 of the Christian era—a period of over 1000 years; that it was fairly exposed to the violent storms of Palestine, and that it was never struck by lightning, as neither the Bible nor Josephus mentions any such accident. As it was covered with wood within and without, it would in all probability have been fired had a thunderbolt struck it. Its preservation is explained in this way: The roof of the temple was made of cedar wood, and the wood was covered with thick gilding. From end to end the roof was adorned with long upright spears of steel, pointed and gilt. These the architect put on to prevent birds from defiling the roof. These metallic spears connecting with the gilding of the roof, and the gilding again connecting with the metallic water-pipes for draining the roof, and these copper pipes again connecting with the water-pools under the porch of the temple, constituted, not by design, but fortuitously, *paratonerres*, and, it may be added, more perfectly arranged than the present lightning-rod. It is a rare thing at the present day to hear of a metallic-covered roof being injured by a thunderbolt. And if, like the Smithsonian Institution building at Washington, such roof, lightning-rod and water conductor be connected by metallic chain or rod to the street water-pipes, it ought to act as a complete protection from the effects of thunderbolts. Such, however, is not always the case. When the surcharge of the cloud above is greater than the capacity of the metallic surface to absorb it, or diffuse it, or equalize it over the surface of the earth, the surplus will be driven into some projecting point or corner, just as the red-hot cinders are driven from the glowing bar of iron under the blacksmith's hammer.

Large metallic surfaces will diffuse the lightning of intensity into lightning of feeble tension—that is to say, it spreads out over its surface, and thus disarms it of its force. To protect a building covered with wood or other combustible covering, broad bands of copper along the apex of the roof, running down the end of the building to water- or gas-pipes, would no doubt afford some protection to the edifice.

A very violent thunder-storm passed over the city of Paris, July, 1866. The atmosphere was black with dense clouds, which, dissolving rapidly into rain, caused the evolution of great quantities of lightning, and, as a natural sequence, the crashing of thunderbolts was frequent and terrific. In one instance it struck a gas-pipe in the street, fused it

and set fire to the gas, causing great consternation in the neighborhood. All this time the tops of the lightning-rods were illumined with a lambent flame. The streets, say some of the papers of that day, were filled with fire, gliding along the watercourses and blazing up from the sewers. From the accounts as given, it would seem as though a reciprocal action of electricity between the clouds and the surface of the earth was going on at the time.

A few years earlier than the Paris thunder-storm several such passed over the cities of New York and Boston, leaving destruction in their tracks, without regard to the averting influence of lightning-rods—indeed, it was more than surmised that the buildings with rods suffered the most. To this the rod advocates responded, "They were not put up right." A person would naturally suppose that during the lapse of a hundred years from the time of the invention of the lightning-rod, it ought to have arrived at a tolerable degree of perfection. Nevertheless, "the bell-ringing," in the shape of the lightning-rod, goes bravely on, and just as bravely does Jupiter meet it with his thunderbolts.

Smithsonian Inst.
April 13th 1858

My Dear Sir

I shall be at home on the 16th & 17th inst. and shall be very glad to spend a day with you in discussing the subject of aerial explorations.

You will find me at the Institution and I shall endeavour so to arrange my business as to have time to devote to you.

I think the investigation

you propose are more
interesting than any in
the whole domain of
meteorology and I am
acquainted with no
person better qualified
than yourself to under-
take them. Indeed
I was about to write
you on the subject
when your letter came
to hand.

Remain very truly
Your obt servt
Jhn Wise Esq Joseph Henry

## CHAPTER LV.

The trans-Atlantic scheme—Attempts to raise money—The "Graphic" undertakes the work—Preparations—Description of the balloon and its outfit.

IT was not until the summer of 1873 that a way was opened to me for the consummation of the design which I had cherished during my whole life—to attempt to cross the Atlantic Ocean in a balloon. The young aëronaut Washington H. Donaldson, of Pennsylvania, had caught some of the enthusiasm with which I had looked forward to such an experiment, and he gladly gave to me his co-operation and encouragement in an attempt to secure means for the purpose. We determined, after discussing the subject thoroughly, to adopt instantly energetic measures to obtain assistance from men of wealth for the undertaking, and in order to attract attention to the subject I delivered a lecture on the night of February 21, 1873, in the hall of the Franklin Institute, at Philadelphia, in which I dwelt upon the probable results of an effort to traverse the ocean with a balloon.

I endeavored to demonstrate the existence of a steady easterly current in the upper atmosphere. I proved, as clearly as could be done by theory, that such a voyage was perfectly practicable and likely to succeed under fair conditions, and I claimed that when the first successful passage was made the feat would certainly be performed many times again, until such excursions became as common and as little worthy of remark as the transmission of messages through the Atlantic cables. I claimed that the achievement of my purpose would do something more than to supply an easy and rapid passage to Europe—that it would establish a fact of the utmost importance to science; that it would give to men a more intimate acquaintance with the laws which govern the vast ethereal sea which surrounds the earth; and that it would help to elevate meteorology to its rightful place among the sciences.

But there was in Philadelphia no response to the appeal thus made, and we both determined to look elsewhere for help. The city government of Boston always makes a handsome appropriation for the Fourth of July, and we entertained a hope that the authorities might be induced to devote a portion of the amount to the furtherance of our scheme. We therefore proposed to them that if they would construct

THE TRANSATLANTIC BALLOON.

a balloon in accordance with our plans, we would start from Boston Common for Europe on the Fourth of July, 1873. This would have surrounded the celebration of the day with the deepest interest, and would have given to that liberal city the honor of inaugurating an enterprise of vast and general importance.

The proposition was very favorably received by the city fathers, and one branch of the council actually passed a bill appropriating a sum of money for our purposes. But a few days later a disastrous fire occurred which laid a great section of the city in ashes; and when the appropriation bill was considered in the other chamber, it was defeated by a small majority, upon the ground that the calamity had made it injudicious for the municipality to apply the public money in such a manner.

This was of course extremely disheartening, but we had made such a near approach to success in our effort to obtain the necessary funds that we were very loth to abandon the enterprise without a vigorous attempt to secure assistance in some other quarter. From Boston, therefore, we turned to New York, and in the metropolis we made earnest appeals to a number of rich men who might be expected to feel a keen interest in our scheme. But the responses were so few in number, and the total amount offered was so small, that it was apparent nothing could be done, unless some business firm could be induced to take the matter in hand and push it through single-handed as a magnificent advertisement.

We found the proprietors of the "Daily Illustrated Graphic" newspaper to be the men for the emergency. They approached us upon the subject; and after a careful consideration of my theories, and an examination of the plans which had been prepared by both of us, they agreed to take upon their shoulders the entire burden of the expedition. It was another instance of the enterprise and liberality of the American press, and another proof of its earnest purpose to ever occupy the foremost place in advancing the interests of science, civilization and the race. The outlay thus assumed was large and the risk of loss not inconsiderable, and it is therefore impossible not to admire the courage which was displayed by these gentlemen in determining to push the enterprise through to a conclusion.

On the 27th day of June, 1873, an agreement was drawn up and signed by the parties involved. Arrangements were immediately made for beginning the construction of the balloon and the necessary paraphernalia. It was determined to construct the gas-bag of muslin, instead of silk, because of the enormous expense attending the use of the latter in an air-ship of such gigantic size. A calculation showed that, in all, 4316 yards of cotton cloth would be required, and that there would be about 14,080 yards or eight miles of seams, with 10,137,600 stitches. For a distance of fifty feet from the summit of the balloon, upon every side,

the material had to be doubled, and still a third thickness was required at the places where the pressure of gas was to be greatest. The necessary quantity of unbleached "Indian Orchard" muslin was obtained, and the necessary stitching began at once at the rooms of the Domestic Sewing-Machine Company, at Broadway and Fourteenth street, where twelve machines were constantly employed.

The balloon when completed, with car and life-boat, stood one hundred and sixty feet high, with the boat just touching the earth. The exterior was coated with about five hundred gallons of oil and an equal quantity of benzine, and finally varnish was applied liberally, so that the bag had a dark-yellow appearance as it rose above the earth. A smaller balloon clung to the side of the greater one. This was constructed in order that an extra supply of gas might be carried along in case of too great leakage from the other balloon, and also to enable one of the aëronauts to ascend the side of the large gas-bag to examine the valve, or to repair the netting, if it should become necessary to do either of these things.

The balloon, when inflated, had a lifting power, including its own weight, of fourteen thousand pounds; and it had a sufficient carrying capacity to permit it to take nearly seven thousand pounds of passengers, freight and ballast. The gas-bag was made large enough to hold six hundred thousand cubic feet of gas while upon the surface of the earth; but as the expansion of the gas is always very great in the upper air, where the pressure is smaller, it was considered prudent to charge the balloon with only four hundred thousand cubic feet; this was sufficient, we believed, to expand the canvas to its full size at the height of a couple of miles. The valve at the top of the balloon was three feet in diameter. It was constructed of cedar, with a rubber-coated clapper, which shut upon a brass plate and made a tight joint. A rope reaching down into the car enabled the aëronauts to open or shut the valve at pleasure.

The network in which the bag was caged was made of marlin rope, with a breaking strength of two hundred and eighty-eight pounds for each strand. The Manilla ropes, which were fastened to the lower part of the net, converged in a ring four feet in diameter, and constructed of gas-pipe. To this ring, also, the ropes which held the car were attached. The car was enclosed in the twenty-four ropes which hung from the hoop overhead. These ropes bore the weight of the car and of the life-boat. The car was made two stories high. At the bottom of it was a strong flooring, constructed so as to resist the pressure of the ropes. This was used, I may say, as a kind of cellar; for here were stored provisions, ballast, etc. Above this, at a distance of four and a half feet, another floor was placed, resting upon a hoop ten feet in diameter. The sides of the room between the two floors were made of rope woven into meshes and covered with heavy canvas.

The apartment upon the second floor was devoted to the aëronauts. It was enclosed in duck, containing four openings for windows. The sides were so arranged that, when desirable, they could be rolled up like curtains, for the purpose of procuring a wider range of vision. Ten feet above the upper floor a hoop was inserted to distend the ropes and the canvas, and here an opening was made, with a rope ladder reaching down into the chamber, so that access could be had to the balloon for any purpose that might be necessary.

Around the walls of this apartment were hung the scientific apparatus and implements for the expedition. Here were the hygrometers, the telescope, the wet and dry-bulb thermometers, charts, mathematical tables, and the hygrodeik, with which to measure the moisture of the atmosphere; two marine compasses, small parachutes, with which to send down messages to vessels; phosphorus and calcium torpedoes, to be flung into the sea at night, so that by the brilliant light thus produced as they struck the sea an idea might be obtained of the direction in which the balloon moved. A liquid phosphorescent light was provided by Dr. Wahl of the Franklin Institute. A place was found, also, for suspending a cage full of trained carrier pigeons, belonging to Mr. O. S. Hubbell, with which to send repeated messages back to New York. In addition to these things, the chamber was supplied with a lime-stove for cooking and making coffee, with camp-stools, a small table, air-mattresses and pillows, writing materials, and a few other articles for the convenience of the voyagers.

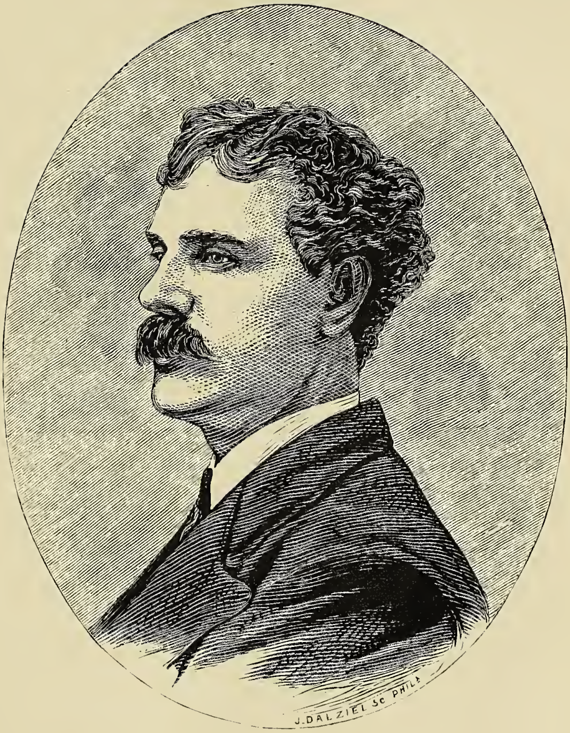
The lower room was devoted to the sand-ballast, in bags containing twenty-five pounds each, for easy handling; water-ballast, in casks; axes, hatchets, saws, coils of rope, tarpaulin clothing, a few guns and fishing-lines, for use in case the party should be landed upon the shores of some uncivilized or uninhabited country; canned and condensed food of various kinds, sugar, and a quantity of other useful articles.

Upon the outside the grappling-anchor, an invention of Mr. Donaldson, was hung, and in the upper chamber was placed a windlass, by which the life-boat could be raised or lowered or the trail-rope lifted. The trail-rope was ordered to be made one thousand feet long and to weigh six hundred pounds. Its purpose was to enable us, as it floated in the water, while the balloon descended, to gauge the descent with exactness. It would serve, too, as it trailed in the air or the water, to indicate the direction in which the balloon moved, while by throwing it from the car to the water, where it would be buoyed up, the air-ship could obtain an upward impetus without really losing any ballast.

Not the least important part of the outfit was the life-boat. This was constructed of cedar, copper fastened, and weighed about 800 pounds. It was made so as to right itself if capsized, and was divided into two air-chambers. It was made with a half deck of wood, which was covered with painted canvas; it was sloop-rigged, with a movable mast, and

was provided with life lines, passed clear around it, so that there would be something to cling to in case the boat should be overturned. For the boat a supply of provisions and water for the party for thirty days was determined on, together with the necessary compasses, charts, fire-arms, life-preservers and navigators' instruments of various descriptions. The mast and sails were so arranged that they could be thrown over as a drag in a heavy sea.

It was decided that in case of an unusual prolongation of the voyage, and a consequent loss of gas, the small balloon should be emptied into the large one and the material cut up for ballast. When everything was thrown from the car to lighten the load, the flooring of the upper room could be tossed overboard, the very car itself could be cut away, and the party could take to the life-boat, which was suspended by strong ropes, and so continue the voyage with the balloon. Then, if land was not sighted, the various articles in the boat could be dispensed with as necessity required; and finally, if the gas entirely gave out, the boat could be placed upon the water and the balloon thrown away. Provision was thus made for every contingency that could be imagined.




Washington H. Donaldson

# APPENDIX.

# APPENDIX.

## INSTRUCTIONS IN THE ART OF MAKING BALLOONS, PARACHUTES, AND ALL KINDS OF AËRONAUTIC MACHINERY.

ALSO,

## DIRECTIONS IN THE PROCESSES OF INFLATION AND PRACTICE OF AIR-SAILING.

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### I.

Introduction—Atmosphere considered as a balloon medium—Cause of failures in small experiments—Table of surfaces, capacities and powers of balloons—Metal balloons—Materials for experimental balloons—Hints for varnishing silk or muslin for balloons.

WHEN we are about to construct a thing, it is always necessary, in order to be the more perfect therein, that we should know what it is for and in what manner it is to be used. Then, as balloons are intended to sail in the air, and must therefore be adapted to that element, it will be proper first to learn the nature and buoyancy of the atmosphere. This element surrounds our globe as one vast ocean of about forty miles in depth, as is theoretically assumed. Its pressure on the surface of the earth is equal to about fifteen pounds for every square inch, which will balance a column of quicksilver of two and a half feet in height, and a column of water of thirty-four feet in height, at the level of the sea. Its specific gravity is one ounce and two-tenths per cubic foot, and thus, if we make a body of any material, of the size of a cubic foot, which shall weigh less than one ounce and two-tenths, it will float in the air and rise up in it, but it will not, as in the case of water, rise to the surface, for the reason that the atmosphere grows gradually thinner, and of course specifically lighter, as you ascend in it; therefore, the body which was lighter than an equal bulk of air at the surface of the earth will just rise to the height in the air where it becomes equal to it in specific gravity. The atmosphere, being an elastic body, differing in this respect from water as a resisting medium, may be

properly illustrated by layers of wool piled upon each other, in which case the lower layer would, of course, be most compressed, while each succeeding layer above would be less and less compressed, as is the case with the layers of atmosphere. And every elastic substance on the earth partakes of this same property as it happens to be placed in the different regions of the atmosphere. Even the human body expands when elevated in the air, and an old wrinkled man will grow full and plump as a youth if he ascends two or three miles high with a balloon.

By observation and calculation it has been ascertained that at the height of three and a half miles the air is but one-half as dense as at the level of the earth, at seven miles only a fourth, at ten and a half only an eighth, at fourteen only a sixteenth, and at seventeen and a half miles only one thirty-second of the density it is at the level of the earth. From this it will be seen that we must be kept within the reasonable range of about three miles from the surface of the earth in aërial navigation.

If the great ocean bed of the sea were to be emptied, and we were to operate with balloons from its bottom level, they would be required of only one-half the size we have them here, to do the same amount of lifting up, computing the depth of the ocean at three and a half miles.

But computing the atmosphere at what it really is where we enter it with balloons, at one and two-tenth ounces per cubic foot—and it does not vary much from this for the first mile of height—it will be seen that we may make our machines of very substantial material, if we make them but large enough, since the cubic contents of globular bodies, or those approaching that form, increase much faster than their superficies. In estimating the ascensive power of balloons which are to be inflated with hydrogen gas we may safely calculate upon one ounce of ascensive power for every cubic foot of capacity. With but ordinary care in generating hydrogen gas we get more, but it is always best to keep on the safe side of the exact estimates. And here I would remark that there is nothing connected with aërostatics that has so much discouraged experimentalists who were trying it on a small scale as the difficulty in succeeding with the ascension of small balloons, where, if they had tried it with some of a larger size, they would, in all probability, have gone on rejoicing. The most of these experiments have been attempted with balloons of from two, three, to five feet capacity, and of course requiring them to be not more than so many ounces in weight when the fuel was in them, and then requiring at that a high degree of rarefaction to enable them to rise, so that in most cases these ends were not attained, on account of the machine being heavier than the air it displaced; and the consequence was a failure of the desired result, and an abandonment of its further investigation, all for the want of properly understanding its first principles, which are so plain and simple that a child may understand them. A chapter to the construction and sending up of toy balloons will be specially given in another part of this work.

The following table exhibits the diameters, surfaces, capacities and

ascensive powers of balloons, computed at one ounce of power for every foot capacity, so that, if carburetted hydrogen or coal gas is used, allowance must be made accordingly. The minute fractions of feet and ounces will not be noticed, as they are of no consequence in the mere practice of the art. The surfaces may be converted into square yards by dividing them by 9.

| Feet diameter. | Surfaces in square feet. | Capacities in cubic feet. | Pounds ascensive power. |
|---|---|---|---|
| 1 | $3\frac{1}{10}$ | $0\frac{1}{2}$ | $0\frac{1}{32}$ |
| 2 | $12\frac{1}{2}$ | 4 | $0\frac{1}{4}$ |
| 3 | 28 | 14 | 1* |
| 4 | 50 | 33 | 2 |
| 5 | 78 | 65 | 4 |
| 6 | 113 | 113 | 7 |
| 7 | 154 | 179 | 11 |
| 8 | 201 | 268 | 17 |
| 9 | 254 | 381 | 24 |
| 10 | 314 | 523 | 33 |
| 11 | 380 | 697 | 44 |
| 12 | 452 | 905 | 57 |
| 13 | 531 | 1,150 | 72 |
| 14 | 616 | 1,437 | 90 |
| 15 | 707 | 1,767 | 110 |
| 16 | 804 | 2,145 | 134 |
| 17 | 908 | 2,572 | 161 |
| 18 | 1,018 | 3,054 | 191 |
| 19 | 1,134 | 3,591 | 224 |
| 20 | 1,257 | 4,189 | 261 |
| 21 | 1,385 | 4,849 | 302 |
| 22 | 1,520 | 5,575 | 348 |
| 23 | 1,662 | 6,371 | 398 |
| 24 | 1,810 | 7,238 | 452 |
| 25 | 1,963 | 8,181 | 511 |
| 26 | 2,124 | 9,203 | 575 |
| 27 | 2,290 | 10,306 | 644 |
| 28 | 2,463 | 11,494 | 718 |
| 29 | 2,642 | 12,770 | 798 |
| 30 | 2,827 | 14,137 | 884 |
| 31 | 3,019 | 15,598 | 975 |
| 32 | 3,217 | 17,157 | 1,072 |
| 33 | 3,421 | 18,817 | 1,176 |
| 34 | 3,632 | 20,580 | 1,286 |
| 35 | 3,848 | 22,449 | 1,403 |
| 36 | 4,072 | 24,429 | 1,527 |
| 37 | 4,301 | 26,522 | 1,658 |

* Nearly a pound.

| Feet diameter. | Surfaces in square feet. | Capacities in cubic feet. | Pounds ascensive power. |
|---|---|---|---|
| 38 | 4,536 | 28,731 | 1,796 |
| 39 | 4,778 | 31,060 | 1,942 |
| 40 | 5,026 | 33,510 | 2,094 |
| 45 | 6,362 | 47,713 | 2,982 |
| 50 | 7,854 | 65,450 | 4,091 |
| 55 | 9,503 | 87,114 | 5,445 |
| 60 | 11,310 | 113,098 | 7,069 |
| 65 | 13,273 | 143,794 | 8,987 |
| 70 | 15,394 | 179,595 | 11,225 |
| 75 | 17,671 | 220,804 | 13,800 |
| 80 | 20,106 | 268,083 | 16,755 |
| 85 | 22,698 | 321,556 | 20,097 |
| 90 | 25,547 | 381,704 | 23,856 |
| 95 | 28,353 | 448,922 | 28,058 |
| 100 | 31,416 | 523,599 | 32,725 |
| 200 | 125,664 | 4,188,792 | 261,800 |
| 400 | 502,656 | 33,510,336 | 2,094,400 |
| 800 | 2,010,624 | 268,082,688 | 16,755,200 |

The great advantage in enlarging balloons arises from the fact that their powers increase faster than their surfaces. When you double the diameter of one, you require four times as much silk to make it, but you get eight times as much capacity, and consequently eight times as much power; therefore, whenever you double the capacity of a balloon you save fifty per cent. in its construction, compared with the ratio of its power. And there is another advantage in the enlargement of balloons; we need not confine ourselves to frail fabrics for their construction, for at a very moderate size we can use copper or iron to make them of. If we use copper in the construction of a balloon of two hundred feet diameter, which weighs one pound per square foot, and deduct this from its ascensive power, we shall have remaining sixty-eight tons of lifting power; and if we allow room for expansion of gas for an altitude of about two miles, and allow five or six tons for the car and its fastenings, we will have left a lifting and carrying power of about forty-five tons. To inflate a metal balloon, if it were made not to be susceptible of collapsing, it would be necessary to insert a muslin balloon in it filled with atmospheric air, and the hydrogen gas passed in between the muslin and copper surfaces, which would exclude the inner balloon as the copper one would fill up. A copper balloon's ascent and descent would have to be regulated by a drag rope on Mr. Green's plan, and the expansion and contraction of the gas in it would have to be provided for by an elastic diaphragm and an opening in the bottom of the machine to communicate between the diaphragm and the atmosphere.

But our object for the present must be to instruct in the art as it is, and these plans of a larger scale will soon follow in the wake when the genius of our country is once properly awakened to its importance.

We can easily operate with balloons of one hundred feet diameter, made of silk or twilled muslin, and one of such capacity has a power of about ten tons, independent of appendages and room for expansion of gas,

Having now before us the calculations of size and powers of balloons, the next consideration will be the material of which they may be made. For balloons for experimental purposes to make ascensions with, and under a capacity of thirty feet diameter, silk or cambric muslin is generally used. Although cambric muslin makes a very good machine, and costs a trifle less per square yard than Indian silk, still, silk is the cheapest in the long run. Any pliable silk will answer the purpose, but the India silks are the most economical and durable for balloons. India sarsenet makes a very light machine, but the India tassore is the kind I have preferred when not wishing to use the pongee, which is dearer. The tassore is made from the product of the wild silkworm, which browses on the shrubbery in the fields, and is the strongest article I have ever found for balloons in proportion to its weight, and it is the cheapest silk per square yard of any that comes to our market. I have never yet had any difficulty on account of durability, strength or the imperviousness of the machine while using one made of this kind of silk. It is imported in twelve-yard pieces, and varies in width from thirty-four inches wide to forty. Sometimes it is strongly stiffened or dressed with a starch made of rice and urine, which it is best to take out by rubbing the silk between the hands, when it will fall out in a fine dust resembling flour.

Thus prepared, the silk is next to be coated with varnish. The first coating may be put on by soaking the silk in warm varnish and levelling it nicely over with a palette knife or smooth spatula after it is stretched out on frames or hung up by its edge. I have always, however, preferred the brush to lay the varnish on with, and the thinner the coatings were put on, the better it turned out in the end. I find that the same weight or quantity of varnish put on in four layers—that is, in four coatings—will make the silk a great deal more air-tight than when put on in only two layers or coatings. This is easily accounted for. Varnish membranes or coats, like all other membraneous substances, are vascular and porous, and by dividing the quantity spread over any surface into many layers you obstruct the pores of the one by the laying on of the next, the pores of the second coat not coming exactly over the pores of the first, and so with the third coat in regard to the second, and so on. This holds good in silk or muslin.

## II.

Of oils—Tests—Table of specific gravity of oils—Preparation of author's invented balloon varnish—Varnish for recoating balloons—Bird-lime varnish—To make bird-lime—Caoutchouc or gum elastic—Caoutchoucine.

THE greatest difficulty I had to overcome in the practice of ballooning was the invention of a good varnish for coating the material of the balloon. I have before stated the vexations and dangers that attended the use of gum-elastic varnish ; and although I shall not recommend it as a substance well adapted to balloon varnish, I will not condemn it. I have my doubts, however, whether it contains in any form or preparation as used for a varnish the unchangeably elastic property which is found to exist in linseed oil when properly prepared. At all events, I have never found gum-elastic varnish to attain a drying property without the addition of metallic oxides in its composition. These oxides have a strong affinity for heat (oxygen), thereby being liable to fermentation and spontaneous combustion, the very plague-spots in aëronautics. There is, perhaps, nothing so commonly used as linseed oil about which there is chemically or experimentally so little known. Even the oil self is not very well known by those who use it. Other oils are frequently sold for linseed oil, and as often used for it, by those who are in the habit of its daily use.

It will, therefore, be well to lay down the tests for the various kinds of oil first. By this the student will know how to avoid in the beginning that which might cause him perplexity and failure in the end.

### OIL TEST.

Doctor Ure says: "M. Heidenreich has found, in the application of a few drops of sulphuric acid to a film of oil upon a glass plate, a means of ascertaining its purity. The glass plate should be laid upon a sheet of white paper, and a drop of the acid let fall on the middle of ten drops of the oil to be tried.

"With the *oil of rape-seed* and *turnip-seed* a greenish-blue ring is gradually formed at a certain distance from the acid, and some yellowish-brown bands proceed from the centre.

"With the *oil of black mustard*, in double the above quantity, also a bluish-green color.

"With *whale and cod oil*, a peculiar centrifugal motion, then a red color, increasing gradually in intensity; and after some time it becomes violet on the edges.

"With *oil of cameline*, a red color, passing into bright yellow.

"*Olive oil*, pale yellow, into yellowish green.

"*Oil of poppies and sweet almonds*, canary yellow, passing into an opaque yellow.

"*Oil of linseed*, a brown magna, becoming black.

"Of *tallow* or *oleine*, a brown color.

"In testing oils a sample of the oil imagined to be present should be placed alongside of the actual oil, and both be compared in their reaction with the acid. A good way of approximating to the knowledge of an oil is by heating it, when its peculiar odor becomes more sensible.

"Specific gravity is also a good criterion. The following table is given by M. Heidenreich:

| | Sp. gr. |
|---|---|
| Oleine, or tallow oil | 0.9003 |
| Oil of turnip-seed | 0.9128 |
| Rape oil | 0.9136 |
| Olive oil | 0.9176 |
| Purified whale oil | 0.9231 |
| Oil of poppies | 0.9243 |
| Oil of camelina | 0.9252 |
| Linseed oil | 0.9347 |
| Castor oil | 0.9611 |

"It will be seen that linseed oil is the heaviest in the list except the castor oil."

## PREPARATION OF BALLOON VARNISH.

Take pure linseed oil, as much as will fill half the vessel, not more, and put it over a fire. Let it heat gradually up to a degree at which it will char wood. Before it arrives at that heat it will show symptoms of boiling, which is, however, nothing more than the ebullition of the small quantity of water that is generally in solution with the oil. Before the oil begins to boil it must be brought to a much greater heat, and, as before stated, to that degree at which a piece of wood immersed in it will be quickly carbonized. At this point it will have to be closely watched, for soon it will commence an intensely heated reaction, beginning to foam and emit dense vapor, when, if not well secured from the air, will soon burst out into flame. By using a boiler with a close cover which has a very small air-hole in it, the operation may be continued briskly for at least an hour, and if not kept up so briskly, for two hours or more. The best way to tell when it is boiled enough is to take out a little with a spatula occasionally, putting it on a piece of glass or tin to cool, when it will be found thick and very stringy when sufficiently done. It will also be of a deep reddish color when ready. If the oil is of a good quality and well boiled, or we might rather say decomposed, in this way, it gets very thick when cooled, and in appearance very much resembles India rubber, and in elasticity is superior to it. Its nature becomes entirely changed as the fatty adhesive property seems to be destroyed in it. After being prepared in this way it should be placed in the light for a while, when it will settle, separating the pure portion by its floating above the black carbonaceous matter at the bottom. Before using, it must be thinned with spirits of turpentine, and this should be highly rectified, in order to make the varnish dry readily. This varnish

will dry in the sun in five or six hours, and requires no *driers* of metallic oxides to facilitate its progress.

Silk or muslin, when coated with this valuable preparation, possesses the peculiar properity of being a *non-conductor* of heat, instead of the dangerous property, pertaining to most oil varnishes, of contracting heat (affinity for oxygen). Balloons prepared with this varnish have been suffered to remain packed up in a chest for months without the slightest development of heat or adhesiveness—a difficulty which cost me more perplexity in the first years of my ballooning than all other obstacles put together.

This varnish improves by keeping; and if kept in a glass vessel, it will improve and become clear faster than when kept in a vessel where the light is shut from it. By keeping it for three or four hours in an intense heat when preparing it in the boiler, it will upon cooling get almost as solid as India rubber. It may be diluted with turpentine as soon as sufficiently cooled down to bear it when first prepared, or it may be partly warmed when it has been suffered to cool and settle after being prepared without having been thinned at the time.

This varnish does not dry so well in the shade; and as it becomes necessary to varnish a balloon sometimes after it is made, which is generally done in a room, the following preparation will be found to answer the purpose very well:

Take of umber made fine, two ounces, common yellow ochre four ounces and litharge one ounce, to half a gallon of the above-mentioned varnish, and boil them well together for half an hour. This will dry very rapidly in the shade or the sun, and should be used very thin for re-coating. A half gallon of it can be diluted with turpentine so as to be sufficient to coat over a balloon of twenty-five feet diameter if made of silk. Cotton ones take a little more.

Having now given what I deem to be the best composition for coating hydrogen balloons, it will not be improper to mention such others as may be used.

### BIRD-LIME VARNISH.

This makes a very good balloon varnish, and is composed in the following manner: Take bird-lime four pounds, boiled oil four pounds. Boil these together until they are perfectly incorporated, then add six pounds more of boiled oil and one pound of litharge (oxide of lead); boil again until the whole mass becomes well intermixed and stringy. This can be ascertained by occasionally taking a little out with a spatula and putting it on glass or tin and trying it. When done, and partly cooled off, add to this quantity about three quarts of turpentine and let it settle, when it is ready for use. This varnish dries very readily in the sun, and should be applied lukewarm.

As bird-lime is an article rarely found in this country, it will be proper to state how it is made: Take the middle bark of the white holly in any quantity; boil it for seven or eight hours in water or until it gets soft; then drain off the water and place it in a pit three or four feet deep

in the ground, and surround it with stones. Let it remain in this place until it passes by fermentation into a mucilaginous state; then take it out and pound it or run it through a crushing mill. After this wash it in several waters, then take it out and let it ferment four or five days to purify itself.

As gum elastic has been recommended for balloon varnish, as well as the first hydrogen balloon having been coated with a solution of it, we will give here what knowledge we have of it.

## CAOUTCHOUC, OR GUM ELASTIC.

This substance exudes from certain plants, when incisions are made into them, in a milky-like fluid state, and congeals when left exposed long to the atmosphere, and when hardened in this manner is of a lightish yellow color. It is generally imported from South America, and that which we get in the shape of shoes and bottles is of a blackish-brown color, which it acquires from being dried in smoky places. It is remarkable for its elasticity, from whence proceeds its popular name. It is soluble in various oils, such as cajeput, sassafras and naphtha, but its most common solvent is spirits of turpentine. When dissolved in any of these substances and used as a varnish, it never regains its former elasticity, but it is said to recover its elasticity when precipitated from cajeput oil by alcohol.

I believe it would dissolve in very high pressure steam, as it has been so softened by steam of four atmospheres as readily to yield under the palette-knife. By proper distillation it yields a volatile liquid of the specific gravity of 0.64, which is extremely light. To this substance chemistry has assigned the name of *caoutchoucine.* It is perfectly limpid, and it is said to be a perfect solvent for the gum it is made of; and it is also stated that India rubber, or, as it is also called, gum elastic, dissolved in this liquid and applied as a varnish, will recover its original elasticity. With this I have not yet tried experiments in coating balloons, because the linseed oil preparation answers the purpose so well, but I have no doubt this caoutchoucine preparation would be very good if it would not be too expensive.

There are many other preparations recommended in receipt-books for coating balloons with, but none that I would recommend the experimentalist in aërial machinery to have anything to do with. The application of metal leaf, such as Prince's metal, Dutch gold and others, I have found to do very well in making aërial vessels tight when applied before the varnish has been quite dry, but these are too expensive for large balloons. They answer an admirable purpose for small ornamental balloons or any kind of aërostatic figures.

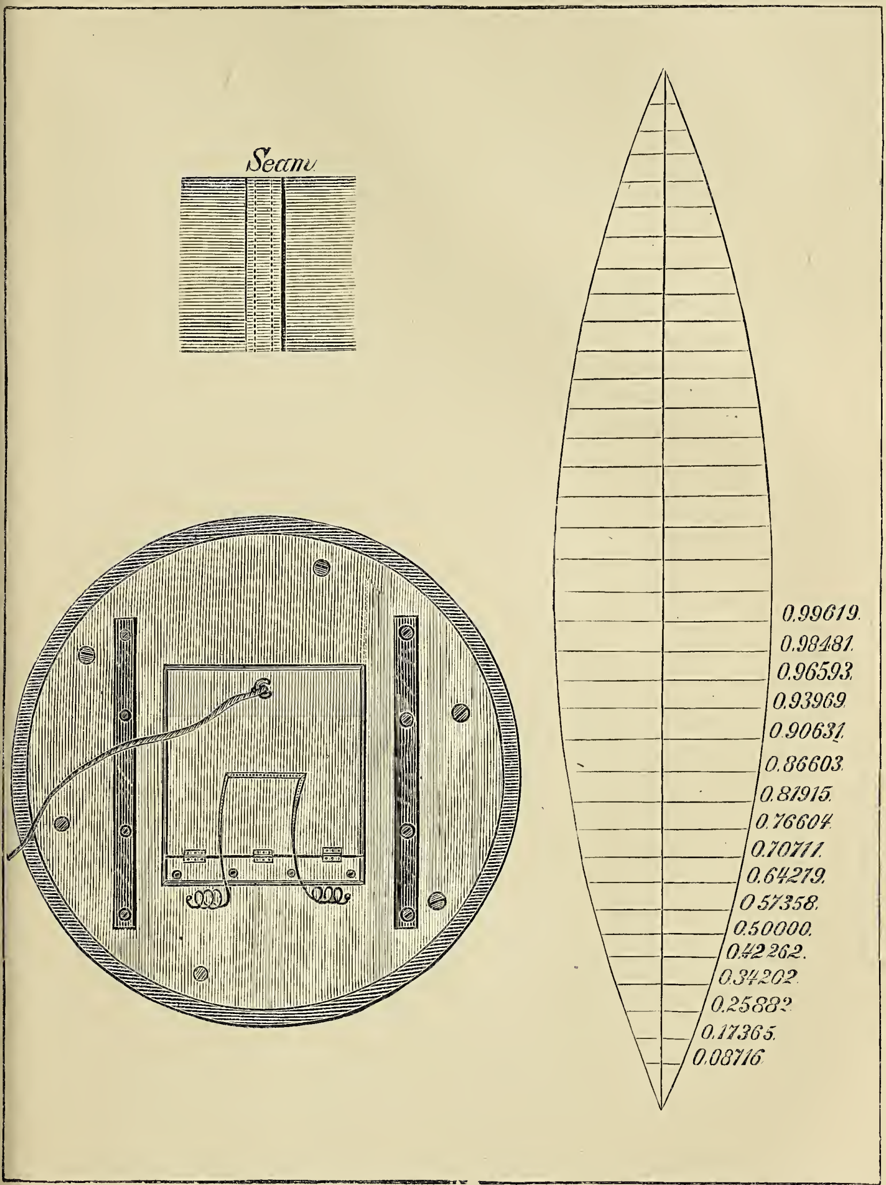
## III.

Scale to shape balloons—How to make a pattern—How to cut material economically—Pear shape—Diameter to circumference—Seams, how joined—Filling with common air—Neck of balloon—Test of balloon—Valve, how made—Net, how made—Rigging and car.

Balloons are generally made of a globular shape, or approximating to it. The following scale will answer to form the segments for a balloon of globular shape, no matter what the width of the material is of which it is to be made. The piece intended for a pattern segment has a line drawn through its middle in length, and one across the middle. This will divide it into four quarters. One quarter is divided by seventeen cross lines at equal distances apart, making eighteen parts of the quarter section. Now, whatever the breadth of this half segment may be, it is to be multiplied by the logarithms in the scale, which will give the length of the line of each division where the curve line is to intersect it. These points once secured, it is easy to draw the curve line with a steady hand. I have generally made a board pattern, as I could by it cut one or more segments at a time by running a sharp knife round the edge of it.

In making my scale for a pattern I merely use a strip of wood which in length is equal to the half breadth of the segment, being the length of the lower line from the centre to the edge. This I divide into ten parts, each part into ten more, thus making tenths and hundredths, which answers all practical purposes. Now, for the length of the first line it will take eighty-seven hundredths full, for the second line, one tenth seventy-three hundredths a little full, for the third line, two tenths fifty hundredths full, and so on. Such a scale can be made very easily with common dividers.

To cut and use the material the most economically, the balloon should be made pear shaped, which is a very good form. In doing so the pieces which are cut from the sides of a piece that is two-thirds the length of a segment will make the lower third of it by sewing their straight edges together and butting it on the other. This will make the central or equatorial part of the balloon cylindrical for six or eight feet. For a common experimental balloon, capable of carrying a man and all necessary appendages, I have preferred the shape made by cutting the segments from a scale calculated for twenty-four feet diameter, and putting in as many segments as would make the machine only twenty-one feet in its transverse diameter, and twenty-two yards, or sixty-six feet, round its equator, since the circumference to the diameter is as twenty-two to twenty-one, gaining one foot in the circumference for every seven feet diameter over and above three times the diameter. This is a mathematical truth balloon-makers must not overlook. Making them on this scale elongates the balloons from top to bottom somewhat, and makes




VALVE, SEAM AND SECTION OF BALLOON.

them of a longish pear shape—a form I have found very favorable to manage in merely experimental operations.

After the varnished material has been properly prepared and cut out, the next process will be to sew it together. This can be done by any seamstress who possesses ordinary ingenuity, but at first will come a little awkward on account of its being an unusual kind of material to sew at. The edges are made to overlap each other about three-eighths or a half an inch, and sewed with a common running stitch, as represented in the cut.

SEAM.

After the seam or seams are sewed they must be coated over on both sides with a drying varnish. One part of drying copal varnish and one part balloon varnish mixed make a very good composition for this purpose. This stops up the needle-holes and insinuates itself between the lap of the seam and consolidates it, which also gives the balloon strength by forming a sort of rib-work in it. Many seams in a balloon made in this manner are beneficial to it, because they give it superior strength; and when they are neatly done, without puckering, they add to its beauty. In joining the segments care must be taken to bring them out in equal length, as any material variation from this would destroy its mathematical figure and impair its symmetry and strength.

In cutting out the segments allowance must be made in their lower ends, so that when the balloon is sewed together it will have an open neck of eighteen inches diameter, which will admit a man's body, as it is necessary to go inside of the balloon in arranging the valve and its cord, as also to examine the perfection of the machine. By using the strips which are cut from the sides of the upper half of the segment for the lower part of the balloon, the neck will be handsomely shaped from them. When the balloon is completely sewed together, it should be blown up—which is easily done by placing a hoop in the neck to keep it open, and then driving air into it with a common palm-leaf fan or a good feather fan—and left for a day or two to see how it holds the air. As it holds common air, so it will hold hydrogen, with the odds in favor of hydrogen. About the diffusion and affinity of gases something will be said hereafter. If the balloon seems not tight enough upon such trial, the application of a very thin coat of varnish, as prescribed in the article on balloon varnish, will be found to produce a very beneficial effect. I have generally coated the material three times before sewing it together, and after being joined coated the seams well, and then used the balloon for one voyage, after which I gave it a complete coat of varnish, when it could be used for eight or ten voyages before it wanted recoating. The heaviest glazed side should be inward, as there may, by carelessness in the process of inflation, some fumes of the heated acid pass into the balloon.

When the balloon is formed, it wants a valve placed in its top; and if it is desired to have more than one, others may be placed in its side, about or above the centre. In common balloons I have found one amply suffi-

cient, as it can be made large or small, to suit the fancy of the aëronaut. Indeed, I never used a balloon with more than one valve in it, but Mr. Green, of London, had several in his large Nassau Balloon. In so large a machine it may be highly necessary.

In balloons of from twenty to twenty-five feet diameter I have used valves of the following dimensions and construction: Two disks of wood one foot in diameter, and each three-eighths of an inch in thickness, are smoothly levelled off. On their inside surfaces are glued a layer of sheep-skin leather, so that the leather projects half an inch over the outer edge of the disk: this is to protect the silk or muslin of the balloon from the more harsh edge of wood. When the disks are thus prepared, they should be screwed together with five-eighths inch wood screws. Then a hole four inches square is cut through the centre.

### VALVE.

The clapper, which is four and a half inches square, so that it overlaps the opening a quarter of an inch all around, is covered with strong pliable sheep-skin leather, which should project about half an inch at the hinder edge to answer for the hinge of the clapper, and by which it is tacked down to the disk. In place of this, however, light brass hinges may be used, just as the mechanic fancies. In the rear of the clapper is inserted a wire coil spring, which curves over and on the clapper, touching it a little behind its middle, and pressing on it to an extent of several pounds at least, making it *self-shutting*, since the pressure of the gas against it amounts to nothing. This kind of spring is used in the common spring mouse-trap, as also in locomotive engine-pipes at their joints to let them down by. I have used various other kinds of springs, but none answered so well as that here described.

When the valve is made, one disk is placed inside the balloon at its top centre, and the other disk on the corresponding outside, and thus screwed together, clasping the silk, which ought to be doubled for a yard or so at the top, between. The piece in the opening part of the valve is then cut out, so that when the clapper is drawn open, a free communication is opened for the gas to escape. On the inside of the valve-clapper a wire ring is screwed or clinched, from which the valve-rope proceeds down through the neck of the balloon into the aëronaut's car.

On the outside of the valve-disk several small rings may be screwed, to which the net may be fastened with slight twine to keep it in its place while the balloon is being inflated. This fastening should not be too strong, as the net would bring an unequal stress upon that point of the machine in case it should slip from its centre, if it were too strong to resist its accommodating itself to the weight below which regulates its disposition over the surface of the balloon.

Spanish cedar I found to be the best wood for valve-disks and clappers. It is light, substantial, and unchangeable when properly seasoned, and is a wood that is easily worked. On the inner side of the disk two ledges, each three-eighths of an inch thick and three-fourths of an inch wide,

should be screwed, a little on each side of the clapper. This will keep the disk from warping, and the surfaces level and gas-tight between the clapper and disk.

### NETWORK OF BALLOON.

When the balloon is made and its valve properly inserted, it wants a network to cover it over for the purpose of distributing the power it is to produce over its surface equally. This may be composed of any sort of twine. Silk makes the lightest and the best, but I have always used a cotton twine, as being in every way best adapted to the purpose. It is soft and elastic, and can be procured from the rope and twine sellers of any required strength. The weight or strength of the twine governs the size of the meshes of the net. If a light twine is used, the meshes should be smaller than for a heavier kind. I have made very satisfactory nets of cotton twine having thirty-six threads in it. It was about the tenth of an inch in thickness. The meshes were of three different sizes; commencing from the centre of the net, they were knit over a five-inch board, which makes a mesh ten inches long when drawn its full length and five inches square when opened. This size meshes were continued for one-third the distance of the net from the centre to its lower edge; from this point the meshes were made over a six-inch board for the next third; and from this they were made over a seven-inch board for the balance of its required size. The size of the net is to be so regulated that the meshes will assume an oblong shape over the upper surface of the balloon. They should stand twice as long as broad when the net bears its burden. At its lower part the meshes should become more oblong, for which the allowance must be made accordingly.

For beginning a balloon net, a round block or board about eight inches in diameter, with its edge slightly grooved, answers a good purpose. Around this groove a quarter-inch cord is to be spliced. Before this cord is put on there should be as many curfs cut in the edge of the block as it will require loops to begin on. At each of these curfs a loop is to be made for the beginning of the nēt, the last loop having its end for the beginning of the knitting process, from which it can be knit round and round to the required size. Its increase of size is made by throwing in half meshes, and these must be regulated according to the mathematical increase of the balloon, which the common arithmetician can calculate by the increased size of his pattern segment.

The net should come down some distance below the equator of the balloon, and ought to cover two-thirds of the machine, but half covered may do. This embraces the fair mathematical process of construction; but a net is of such an accommodating and elastic nature that almost any form or shape will answer, provided it is big enough. It may be begun by simply knitting a square piece of the size of a yard, and then commence knitting around and increasing it according to the size of the balloon it is to cover. I saw one knit in this way by Mr. Paullin which answered the purpose very well, but the first directions are the best, and will recommend themselves from their simplicity and comprehensive-

ness. A much lighter twine may be used than above stated by making the meshes smaller, but in that I have experienced a difficulty in the part of the net where the main cords were attached to it, in landing in strong winds, by its tearing, although more strands were fastened to the main cord, while with the heavy twine in the net I never had a single strand of it broken, though branches were torn from trees and fences pulled down in the progress of the balloon's landing, all of which force came upon the netting.

From the lower edge of the net proceed the cords to which the car of the aëronaut is suspended. For a twenty-two feet diameter balloon twenty attachments are sufficient. Two attachments converge into one joining six or eight feet below the net, which will make but ten main cords to come down to the concentrating hoop, at which point the connection of the car to the net should be made. This I have always done by simply tying the ropes together, but the aëronaut may use his own fancy for that. The concentrating hoop should be at least six feet below the lower extremity of the balloon when it is all rigged. From the concentrating hoop down to the balustrade hoop twenty cords proceed, and these should be worked in with the wicker-work of the car, going clear down its side, across the bottom and up the other side, in order to make the car perfectly secure in its bottom.

The tying, splicing and joining of the various cords may all be done according to the operator's particular taste and fancy. Much ingenuity and ornament may be exercised, as is the case in the French aërial machinery. Solidity and safety should, however, be the main point of consideration.

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## IV.

Weight of hydrogen—Vitriolic process of inflation—Strength of sulphuric acid—Apparatus illustrated—Balloon, how kept under process of inflation—Pure hydrogen process of inflation—Carburetted hydrogen for balloons—Its consideration in the future prospects of aëronautics.

After the balloon is made and properly rigged it is ready for actual service; but in order to make it useful, it must be inflated with a substance lighter than atmospheric air. The lightest of all ponderable substances of which we have any knowledge is pure hydrogen gas. This gas exists as an elementary component part of almost every substance in the world, and particularly in matter of a combustible nature. In most cases it is evolved compounded with other gases, particularly from bituminous coal, when it is mixed with carbon, generally termed vapor of carbon. From this it can be separated and purified by passing it through porcelain or earthen tubes heated white hot, where it deposits its carbon. The most ready means of procuring it pure is by the decomposition of water, of which it is a constituent. The gaseous combination of water consists of eight atoms of oxygen and one atom of hy-

drogen. The one atom of hydrogen is twice the bulk in size of the eight atoms of oxygen when liberated in their gaseous states. Hydrogen is sixteen times lighter than oxygen, and over fourteen times lighter than common air. Thus, if we use pure hydrogen for ascending power, we shall have full thirteen-fourteenths of the atmosphere's buoyancy, which would be seventy pounds for every thousand cubic feet of gas in the balloon. But in generating hydrogen by decomposing water with oil of vitriol and iron or zinc, it is liable to impurities, so that we get only from sixty to sixty-five pounds to the thousand cubic feet. But by decomposing water in passing its steam or vapor through heated iron turnings we get the hydrogen pure and an ascending power of seventy feet. And so we will by passing coal gas (carburetted hydrogen) through heated porcelain or earthen tubes, in which it deposits its carbon, and is consequently purified.

### VITRIOLIC PROCESS OF INFLATION.

The readiest means for procuring a large quantity of hydrogen gas in a short time is by the vitriolic process. With eight or nine common rum-puncheons of 130 gallons each for retorts as gas generators, 5000 cubic feet of hydrogen can be evolved in one hour. To effect this with eight casks—air-tight ones—each must contain seventy gallons of clear water and 125 pounds of iron in the shape of turnings or borings of clean cast iron, or card teeth, or fine particles in any shape; and if nails or other heavy scraps are used, it will require more in proportion, since the time of oxidation is according to the *surface* presented by the iron to the acid. Into each of these casks 144 pounds of oil of vitriol of the specific gravity of 1.85, which is the common strength, must be poured at once, which in one hour will produce 600 cubic feet or more of hydrogen gas. The proportions in weight are as follows: Water, 560 pounds; oil of vitriol, 144 pounds; iron turnings, 125 pounds. In operating on a small scale the formula is: Vitriol, one pound; iron, one pound; water, four pounds, which will produce four cubic feet of hydrogen. In the arrangement with the eight casks they may be all put in operation at once, or only a part of them at a time, just as the operator may prefer, or as his arrangements for cooling and washing the gas may permit. It should be run through a head of water of eight or ten inches, supplied with ice; if ice cannot be procured, a running stream of cool water passing through the cooling tub will answer equally well. There should be a peck of lime dissolved in the water of the cooling tub to absorb any carbonic acid gas that may be generated, as this gas is heavier than atmospheric air.

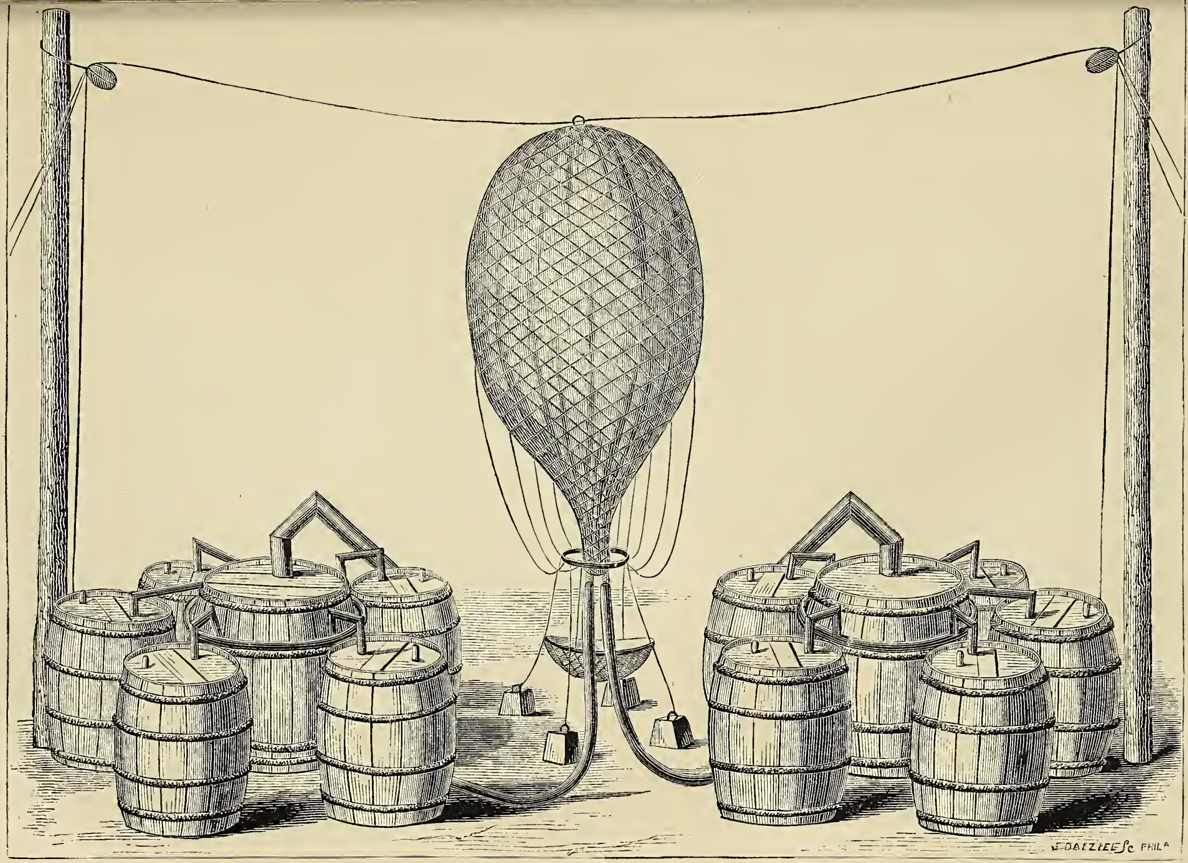
This process takes place under the law of chemical affinities. The water being composed of oxygen and hydrogen in *liquid* combination, these must be separated and rendered *gaseous*—at least the hydrogen, which we want, must be rendered so. Iron exposed to water extracts from it the oxygen without any other agent, but this is greatly facilitated by adding sulphuric acid, or, as it is commonly called, oil of vitriol. This acid is formed of water highly impregnated with oxygen, and it has a

powerful effect in separating the atoms of which iron is composed when water is present to supply oxygen to unite with the atoms of the dissolving iron. Now, the oxygen of the water having a stronger attraction or affinity for the atoms of iron than it has for the hydrogen with which it is associated, it leaves the latter and incorporates with the former, and the hydrogen is set free, as is also the caloric of *fluidity*. The iron and sulphuric acid mingle with the undecomposed water in the retort, and the hydrogen passes off through the tubes and up through water into the balloon; the caloric is absorbed and diffused, the greater portion of it neutralized in the cooling tub.

In testing sulphuric acid, it is compared in its weight to that of water. Good sulphuric acid is nearly twice as heavy as water. As, for instance, a certain *measure* of water will weigh 100 grains, an equal *measure* of good sulphuric acid will weigh 185 grains. This is its officinal strength; and when weaker than this, it is not well adapted to the evolution of pure hydrogen by decomposition of water.

The apparatus, as shown in the plate, is the kind I have always used. The casks may be arranged in one or two sets. The number of casks used as retorts can be varied according to size. If they hold but sixty-five gallons apiece, sixteen can be used, and even barrels can be used, if only the number is increased in proportion to the diminution of their capacities. For the larger kind of casks two-inch tin tubes are sufficient to pass the gas from the retorts to the cooling tub. The cooling tub should hold at least 150 gallons of water, and be of a shape which will receive a common sized hogshead with its *under* end open into it, having space enough between it and the inside of the tub for the gas pipe to pass down between them, and its recurve terminate under the inverted hogshead, or gasometer, as it is called. These gas tubes should have flanches half an inch from the end which goes in the head of the retort, by which they may be securely tacked down with 16 oz. tacks, with putty under the flanch to make an air-tight joint. The tube which passes the gas from the cooling-tub or gasometer to the balloon is also to be made of tin, and with a flanch but of four inches diameter. From this main tube to the balloon the gas passes through a hose made of stout muslin, rendered air-tight with balloon varnish, and the connection at the entrance of the balloon is made by a short four-inch tin tube.

While the balloon is under the process of inflation, it can be handily kept to its place by the net-cords being fastened to weights. Although I have always commenced the inflation with the balloon lying on the ground, I do not hesitate to recommend the plan of hanging it up as represented in the plate, since by such plan the net can be more easily adjusted and kept to its proper centre than by the other. There should be extra ropes proceeding from the net by which the balloon is held down during its inflation, so that the car may be harnessed to the rigging without disturbing the weights which hold it down, and these should only be loosened when everything is ready for a start.




INFLATING APPARATUS.

### PURE HYDROGEN PROCESS.

This is done by passing steam through iron turnings heated red hot in iron cylinders or retorts. Such an apparatus would be more economical than that just described for a stationary one, and where continuous quantities were required. The retorts must be made of heavy cast iron three quarters of an inch in thickness, and of ten or twelve inch calibre and about eight feet long. Three of these, set in a furnace of firebrick similar to the retorts in gas-houses, would be capable of generating fifteen thousand cubic feet per day. The ends of the retorts must come a little outside of the furnace, and must be so contrived as to receive the steam in one end through a tube which can be regulated by a valve, and another tube from the other end through which the gas passes into a cooling vessel, and thence into the balloon. One end of the retort must be provided with a bolt-head, which can be taken off and put on when required, for the purpose of taking out the residuum and introducing fresh iron turnings. Gas made by this process is pure and inodorous, is fourteen times lighter than common air, and will give seventy pounds ascending power for every thousand cubic feet.

### CARBURETTED HYDROGEN.

As stated in the preceding article, this also is an economical preparation, where things necessary for inflating balloons may be kept at one place. However, this kind of gas being so generally introduced through the streets of all cities and towns, its use in aëronautics is destined to become a most important branch of its consumption. The companies generally have large gas-holders at their works, from capacities of twenty thousand cubic feet up to one hundred thousand, and some to a million. In the smaller works a day or two's notice for a supply sufficient to inflate an experimental balloon of eight or ten thousand cubic feet capacity would enable them to work into their gas-holder that much more than their regular consumption without injury or inconvenience to their works. In the larger works, as they exist in our principal cities, such a quantity would scarcely be noticed in their regular operations.

This gas is evolved from bituminous coal subjected to a red heat in retorts. The process is very simple, as heat alone evolves the gas, together with some tar and ammoniacal liquor, which is deposited as soon as it gets to a cool place and the gas for purification is passed through dry lime. It can also be purified by passing it through wet lime, as described in the vitriolic process. It is composed of two atoms of hydrogen and one atom of carbon. The first portion of the gas as it is evolved from the coal is heavier than the latter, but its general specific gravity is about one-half that of atmospheric air. A ton of bituminous coal will yield ten thousand cubic feet of gas sufficiently carburetted for illuminating purposes, and will yield considerably more of a *lighter* specific gravity which would answer admirably for balloons, but which is never extracted by the gas-lighting companies, on account of its want of carbon, and consequent poor illuminating power.

It may yet become a business question with the gas-lighting companies whether they may not, profitably to themselves, erect a gas-holder expressly to collect these *lighter* portions of the gas to supply aëronautic purposes—especially in the larger works. From the gas, as now manufactured by the baking of bituminous coal, we can get one-half of atmospheric buoyancy, being thirty-five pounds ascending power for one thousand cubic feet of gas. Hence, a balloon capable of carrying an ordinary-sized man should not be of a less capacity than ten thousand cubic feet. This would be sufficient to allow for expansion of gas where the balloon attained a height of one and a half miles. But by a very simple process, and by the additional cost of probably an amount equal to first cost, it could be rendered nearly twice as powerful in its levity by extracting its carbon from it in running it through heated earthen tubes.

For an aëronautic establishment a gas-work could be erected, which would render the cost of inflating balloons with purified gas a comparative trifle compared to what it is at present. Such an establishment in any of our large cities would soon pay a profit equal to the best gas-lighting company's stock. The recreative effects upon invalids of ascensions into the upper regions of the atmosphere would soon bring them into repute far beyond any other means that have been yet established for such purposes, to the elucidation of which some remarks will be given in the concluding part of this work, since the author himself has been relieved of chronic dyspepsia, and can therefore speak from experience.

It should have been mentioned in connection with the vitriolic process that zinc, in a granulated or otherwise divided state, answers quite as well as iron for decomposing water.

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## V.

Directions for balloon sailing—Grappling-irons—Guide-line—Index—Instruments—Descent on woods and waters—How to manage—To collapse balloon—How to fasten grapple-ropes—Caution after descent—Folding of balloon—Height instrument—Parachute, how made—Parachutes in the vegetable and animal kingdom—Pope and Darwin's ideas.

Having given a description of the process of making and inflating balloons, our next object will necessarily be to learn their management while using them as a means for navigating the atmosphere. In order to be fully prepared for an experimental voyage, the aëronaut should be provided with two grappling-irons of about two and a half pounds weight each, or they may be heavier if he is not particular in the economy of carrying weight. The ropes attached to these irons should be from two to three hundred feet in length, and should be strong enough to bear a strain of four or five hundred pounds. A short rope of thirty feet, capable of bearing a strain of a thousand pounds, should be carried along, to attach to the strongest grapple instead of its thinner rope, to be used

when a landing is to be effected under a strong wind. But in such case it is better to choose a landing-place behind a hill or a wood, which will form an excellent harbor for the balloon, and which can as readily be attained by the practical aëronaut as the bay or breakwater can by the argonaut or water sailor. A line of six or eight hundred feet, capable of bearing a hundred pounds strain, should also be carried along; it will answer a very good purpose when descending in calm weather, as by it the aërial vessel may be moored to any required place by any person who may be at the point of its descent. This rope also answers another useful purpose. By having light ribbons tied on it, one at its lower extremity, one a hundred feet higher up, and a third one hundred feet above that, the aëronaut can tell the direction of a contrary current into which he may be descending some time before he reaches it, a knowledge of which may be very essential to his proper and safe landing. He should also be provided with an index of rising and falling. This is a light ribbon a foot long fastened to the end of a three-foot stick, which may project from the side of the car. When the balloon rises, the ribbon hangs straight down, and is tremulous; when the balloon descends, the ribbon coils upward, and under a rapid descent it stands straight upward, with a tremulous motion. Pieces of paper thrown overboard also indicate the rise and fall of the machine, but not so well as the index; for when the vessel is sailing along in equilibrium, neither rising nor falling, paper will still descend, but the index ribbon does not then move; it hangs perpendicularly down and quiescent, apparently as perfectly becalmed as though it were in an exhausted receiver; and it makes no difference whether the balloon is at the time sailing at the rate of one mile per hour or at the rate of one hundred miles per hour.

When the aëronaut is sailing along with the wind, his vessel becomes part and parcel of that element, as far as velocity of horizontal motion is concerned, and the whole machine is relatively becalmed; therefore it is plainly seen that sails or rudder would be of no avail under such circumstances. The aëronaut experiences no cutting breeze, as does the traveller on a steamboat or railroad car.

A compass and map should always be carried along, to enable the aëronaut to tell where he is going and the nature of the country over which he is sailing. When immediately above the clouds, the aërial ship sails in the same direction with the clouds, and in such cases it is impossible to tell what direction the balloon is taking, or whether it is making any headway at all. I have sailed in the current which moved the clouds immediately beneath the air-ship, and made headway at the rate of fifty-two miles in forty-two minutes, without at the time seeing that I was going at any velocity at all. This is easily comprehended, since the clouds that were with me at the start were also with me at the end of the voyage, so that everything held the same relative position during the whole flight. When the clouds are broken so that the aëronaut can see the earth at places, it is otherwise, for he can then see objects moving, as it were. But when the air-ship is permitted to rise a considerable

height above the clouds, it generally gets into another current, in which case the course of the clouds forms an angle with the line of direction of the balloon, which enables the aëronaut to tell his course, as well as the speed which he is at the time making.

After the aëronaut has sailed as far as he desires, or reached his point of destination, his next object will be to effect a good landing. If he is a novice in the art, some difficulties may beset him, since *practice* is the only school in which we can acquire substantial knowledge, but at the same time proper directions will be of great use in this branch of the business. If the balloon happens to come down when all the ballast has been expended, it will then be impossible for the aëronaut to govern its descent to any great degree. He may avoid coming down on an isolated object by exerting against the air a common fan, sufficient to diverge from such point, so as to escape a tree or a house, if it should be in the way. But a river or forest he cannot avoid under such circumstances, and he should not, therefore, be alarmed. If he come down on a forest in a strong wind, the car will rebound the moment it strikes the elastic branches of the tree-tops, and the machine will thus *ricochet* along without any unpleasant consequences to the aëronaut, and at the first clear space he can make his descent. On such occasions he must remember to keep his grappling-irons inside of his car until the moment arrives for their use. If the balloon happens to come down on a river or lake, there is no cause for alarm, as the car will not sink many inches in the water; and if it is in the form of a boat, it will sail as well on the water as it did in the air, the balloon acting as a sail. If it be calm weather, the car or boat may be paddled along with very little effort. If the weather is calm in coming down on a woods, the aëronaut can easily guide his bark by the tree-tops to a point where the most room presents itself to let the balloon through as it gradually collapses.

The balloon may be provided with a collapsing rope, which I would recommend to novices, since they might become unnecessarily alarmed in a first adventure when landing under a high wind. A common twenty-three feet diameter balloon, upon which all these directions are based, will chafe very fiercely under a gale of wind when the grapple has taken effect. In such case the explosive cord may stand the inexperienced aëronaut in good need, as by a sudden jerk of it the balloon can be exploded instantly, when it will fall to the ground powerless. This explosive arrangement consists in fastening a stout line securely against the outside of the balloon at a point a little below its equator; from this let it run up four or five feet, or more, and there enter the balloon; at its place of entrance it must be secured by cementing a piece of oiled silk over the aperture to make it air-tight; from this point the line or cord proceeds down through the neck of the machine into the aëronaut's car. It must be so marked as to distinguish it from the valve-cord, as they are about of the same strength.

The anchor-ropes, or, more properly speaking, the grappling-iron ropes, must be fastened at the upper edge of the car, as then, when the balloon

draws one way, the grapple draws the other, and these two forces being in opposite directions, and both proceeding from the same point, the car is not much disturbed by it. To fasten the rope at the bottom of the car, as has frequently been recommended, would, in a heavy wind, cause it to tilt over.

When the aëronaut has made his descent and is discharging the gas by the valve, he should not leave the car until the balloon is nearly exhausted. Though many persons may come to the place of his descent and become engaged in rendering him assistance, still, if they have been unaccustomed to such operations, they are very apt to become alarmed when a squall of wind happens to agitate the balloon, and let it go. This happened to me on one occasion when the balloon was more than two-thirds exhausted. I had the top of the balloon drawn down and had hold of the valve, when a squall of wind alarmed the persons who held by the cords, which they let go; and seeing this, I held firmly to the valve-disk, but the machine rolled off with a violent surge, jerking me several feet from the ground, and leaving in my hands the whole valve, with part of the balloon remaining to it; it did not come down again until it had drifted off nearly two miles.

After the balloon is emptied of its gas the net should be taken off; it may then be rolled up and packed in a canvas bag, or one made of stout twilled muslin, which the aëronaut should always carry with him.

These are general directions and recommendations suggested to the young practitioner of aëronautics, upon which it is desirable he should improve as fast as the progress of the art will inspire him to do. As for philosophical instruments, log-books and journals, he will of course exercise his own pleasure and judgment. The barometer is an instrument which it is very difficult to carry along and bring down safe in rough weather. It should be suspended from the concentrating hoop, and even there it is liable to derangement when landing under squally weather. As an instrument for measuring altitudes based upon the diminution of atmospheric pressure, I have used a common porter-bottle, to the neck of which was joined a bladder of the same capacity as the bottle. The bottle being filled with air of the density at the point of starting, and the bladder tied on then in a collapsed state, the expansion of the air in the bottle would gradually fill the bladder as it rose up in the rarer regions of the atmosphere. When the bladder became completely distended, it indicated a barometrical height of about fifteen inches, or over three miles high from the level of the sea. A height-indicating instrument might be made on this principle, which would tell it with as much exactness as the barometer, and would not be so liable to derangement as an aëronautic instrument. The one I used would only tell one point with exactness—that at which the bladder became filled; the intermediate points were merely calculations from guesswork of the amount of distension in the bladder.

To explode the balloon when high in the air and convert it into a parachute, the manner of doing it and the fixtures necessary to its

operations have all been described. The parachute, as a distinct machine from the balloon, will be our next subject of consideration.

## PARACHUTE.

The concave parachute, for experimental and scientific illustrative purposes, may be considered the best. This can be formed of almost any kind of cloth material, but common domestic muslin of a substantial texture answers the purpose very well. One sufficient to let down an ordinary-sized man in safety should be twenty-two feet across when opened, and should be of a shape considerably more flattened than a hemisphere. If of a hemispheric shape, it need not be more than twenty feet across when opened, as this form will condense a column of air more rapidly than a flatter form will in its descent. This calculation is for a minimum size, which may be increased by the aëronaut as he fancies, since an increase of size will cause a corresponding retardation of velocity in its descent. The segments of which the parachute is to be formed may be cut by the scale for cutting balloons, and may be so varied as to give it a more flattened form than a half sphere. These segments may be joined by a lap or a welt seam, according to fancy, since its object is merely strength. The parachute may be covered with a net or with cords. The latter is the most simple, and answers the purpose perfectly well when properly arranged. The apex or central joining of the parachute must be formed of a block of wood with a hole through it sufficiently large for a rope to slide through. The cords which sustain the car of the aëronaut are fastened to this block, and proceed down along each seam on the outside of the canvas, and should be fastened along the seam and at the edge of the parachute where they pass over it. The car is rigged to these cords, as represented in the plate of Hampton's parachute, and is supported by the rope with which it is attached to the balloon, and which passes up through the hole in the block. When the parachute is detached from the balloon, by loosening this rope, there is some danger of the rope flying against the inside of the parachute and injuring it. To obviate this, it may be guided safely by passing it through tin tubes setting upon each other from the car to the block, which fall away as soon as the parachute is detached from the balloon. For the further security and certainty of the immediate opening of the parachute, a six-feet diameter hoop may be suspended from the inside of the block, which will keep the parachute that much open, ready at once to receive a column of air in its descent. For safety and certainty Mr. Hampton's parachute is the best.

It has been suggested by some writers on this subject that the parachute be made with a shutter or valve in its top, thinking that such contrivance would answer to regulate its descent in making it uniform, and prevent the violent oscillations which arise from the condensation of the atmospheric column upon which the machine acts when coming down. This method promises very well in theory, as a column of air rushing up through the open shutter of the parachute as it was falling

would seem to act the part of a guide-pole, over which the machine would slide down perpendicularly with a uniform motion. But when we consider the elastic nature of the atmosphere, and the very exact proportions of the opening for the column of air to pass through to that of the surface of the impinging material, and the weight which drags it along, and then its liability of falling through various air currents which would strike it laterally, it would seem to promise but little advantage in practice. However, it would be worth the trial; and although parachuting seems to be of no great practical consequence to the art of aëronautics, its science embraces the highest mathematical considerations and properties connected with it.

We have a beautiful illustration of this principle in various departments of nature. The flying squirrel moves in parabolic curves from tree to tree on the parachute principle. The pollen of plants is carried from one place to another by this mode; the beautiful parachutes springing from the common thistle and the dandelion plants have been noticed by the common observer; indeed, nature uses the atmosphere as its common highway, upon which it has continually myriads of its vehicles floating for the purpose of interchanging, interpregnating and improving the vegetable kingdom upon the aëronautic parachute principle. The phenomenon of frequent occurrence, erroneously believed to be a deposit of sulphur, which is seen on the surface of our rain-water casks after thunder-showers, is nothing more than a deposit of pollen caught with its parachutes in the stormy elements, which destroyed the little air-vessels and dashed the pollen down with the rain. In the ocean we also have the principle naturally illustrated. The nautilus and sea anemone move altogether on this principle. The former embraces the principles of navigation and parachuting, and Pope very beautifully says of it,

> "Learn of the little nautilus to sail,
> Spread the thin oar and catch the driving gale."

If Nature works upon this principle so extensively, it is certainly well worth our while to study it deeply, since it is well known that our highest attainments in the arts and sciences are but attempts to imitate Nature in her more perfect works. By so doing we shall soon realize the prophetic expectations of Darwin expressed in his inspired poetry:

> "Soon shall thy arm, unconquered steam, afar
> Drag the slow barge and draw the rapid car,
> Or, on *wide waving wings* expanded, bear
> The flying chariot through the fields of air."

And if not by steam-power, by some power more adaptable to the ends of aërial navigation, which the progressive spirit of the present age is fully competent to bring out.

## VI.

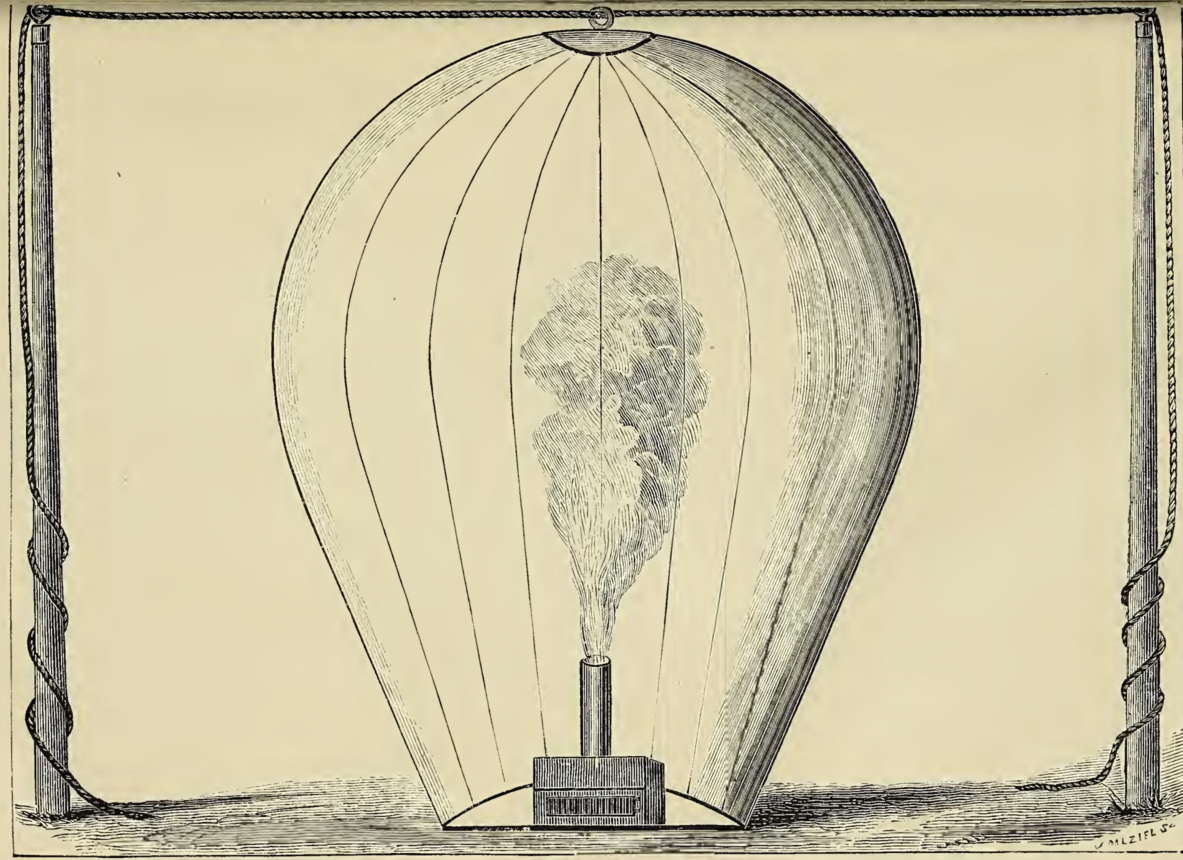
Rarefied air balloons—Laws regulating them—Their powers considered—How to construct them—How to inflate them—Experiment illustrated—An ascent with one described.

### RAREFIED AIR BALLOONS.

Although rarefied air balloons have almost fallen into disuse since the hydrogen balloon has been rendered more available as an aëronautic machine, still, a description of the mode of manufacturing and inflating them should be imparted to the student and experimentalist of the art.

The ascent of rarefied air balloons is governed by the same pneumatic law which applies to hydrogen balloons. The means by which the machines are rendered specifically lighter than common air are, however, very different. In the hydrogen balloon the buoyant agent is a permanent body, unchangeable in its nature under ordinary circumstances. In the rarefied air balloon this agent is not permanent, but dependent on another which requires a continuous application of combustible material to keep up its buoyant property.

Common air expands by heat and contracts by cold. When a body or portion of it is heated more than that by which it is surrounded, it will rise; and if it is rendered colder, it will sink in it. On this principle the rarefied air balloon depends for its buoyant power. Common air increases one-four-hundred-and-eightieth of its bulk for every additional degree of heat it gets; and since its weight is as its density, it follows that this increased bulk weighs one-four-hundred-and-eightieth less than an equal bulk of air whose temperature is one degree less. Consequently, as we increase the temperature of air in the balloon, so we increase its ascending power, and so long as the temperature exists, so long its proportionate ascending power continues. As soon as this temperature diminishes, so soon also diminishes this power. Hence, in order to keep a rarefied air balloon afloat in the atmosphere any length of time, it becomes necessary to carry with it fuel for the purpose of keeping up the heat of the air with which it is filled. If we send it up with a heated body of air in it, and no fire along, its flight must be necessarily brief, as an equilibrium between the enclosed and outer air will soon follow in the high and colder region of the atmosphere to which it will be driven. The rarefaction of common air by this process seems to come justly under the principle of dilution, since from a given body of common air a portion is expelled, a lighter substance (caloric) taking its place. On the same principle, if we take a bottle full of water and force into it, while it has vent, a portion of spirits of wine, a part of the water will be expelled, and the bottle will be filled with a compound fluid specifically lighter than water; and if the bottle were porous, as is the case with the rarefied air balloon, and placed or immersed in a body of



INFLATION OF A RAREFIED AIR BALLOON.

water, an equilibrium would soon be brought about between the inner and outer liquid, unless some contrivance attended the bottle by which a stream of spirits of wine was forced into it faster than the diffusion of the liquids would compensate for. Hence, by increasing the temperature of a given quantity of confined air, we drive a portion of it out, and put in its place an equal bulk of caloric. The latter substance is the material cause of heat, and occupies space.

As common air is expanded by heat to the extent of one-four-hundred-and-eightieth of its bulk for every additional degree of Fahrenheit it attains, it follows that a balloon whose capacity is one thousand cubic feet, and filled with air one degree warmer than that which surrounds it, must be one-four-hundred-and-eightieth lighter than the weight of an equal bulk of that which it displaces. Now, as common air weighs one and two-tenth ounces per cubic foot, a thousand feet weighs twelve hundred ounces, and the one-four-hundred-and-eightieth part of that makes two and one-half ounces, so that for every additional degree of heat put into this quantity of air, we drive out two and one-half ounces of ponderable matter, and occupy its place with caloric or imponderable matter. Increase this heat to a hundred degrees above its common temperature, being that of the atmosphere at the time of making the experiment, and we shall have gained sixteen pounds ascending power, nearly. If the atmosphere at the time of the experiment is fifty degrees, the heat inside the balloon will be one hundred and fifty degrees. If we use a balloon of ten thousand feet capacity, we will, at this rate, gain an ascending power of about one hundred and sixty pounds. From this we see that rarefied air balloons must be made of very large dimensions in order to carry up aëronauts, as it is not very practicable to attain a degree of rarefaction much beyond that which we have just mentioned. And in order to succeed in going up with one, it should hold from fifty to sixty thousand cubic feet. The only one that I ever saw used in the United States with which a person ascended on this principle held about sixty thousand feet, and the aëronaut carried no fire up with him.

## CONSTRUCTION OF RAREFIED AIR BALLOONS.

Common stout muslin answers the purpose very well; and in order to make it retain the heat better, it should be coated slightly with a composition of common ochre, glue and water, made into a consistency of what is termed size, or common water color. Before this is put on, the lower part of the balloon should be soaked in a solution of alum, or sal ammoniac, which renders it non-combustible, and averts the danger of the machine taking fire while in process of inflation. The segments should be joined by a lap seam substantially sewed, which makes the machine firm. It must be remembered that the rarefied air balloon carries no network over its surface; therefore its main strength must depend on the material of which it is made and its seams. The form of the balloon should be oblong, of such proportions that when the machine is

forty feet in its transverse diameter it should be sixty feet in its perpendicular diameter. This dimension is a convenient size for one to carry up an aëronout. To form such a one the segments must be cut by a pattern for a forty feet diameter balloon—that is, the upper half of it—its central part straight, making its shape cylindrical one-third of its height, and the lower parts tapered off, so as to finish the machine with an opening in its lower part of thirteen feet four inches, being one-third of its transverse diameter. This makes the machine globular at the top, cylindrical along its middle and egg-shaped in its lower part. In the lower orifice a hoop of tough wood must be inserted; and as this carries the whole weight of the aëronaut and his appendages, it is best to make the lower part of the balloon of stronger material for a distance of five or six feet up from the hoop. This hoop need not be sewed in, if the lower edge be worked full of loop-holes, by which it may be strung fast with stout twine. From this hoop proceed the cords, in the same manner as they are described to do from the net of the hydrogen balloon; and the same rule and rigging from this point apply in both cases.

The engraving represents a sectional view of a rarefied air balloon in process of inflation. A Frenchman by the name of Vardalle made several ascensions with a balloon of this kind from the vicinity of the city of Philadelphia in the fall of 1849. His machine was about forty by sixty feet in size, and was composed of black twilled muslin. When prepared for inflation, it was suspended from a rope which ran across from two poles erected for that purpose, so that just before starting he could loosen one end of it and draw it out of the ring at the top of the balloon. The process of inflation on the occasion, where I was an eye-witness, was conducted in the following manner:

The balloon was suspended from a rope, as represented in cut, its lower part touching the ground. Inside of the balloon on the ground stood a common sheet-iron furnace surmounted with a flue about six feet high. Near the balloon on the outside was provided a quantity of straw—about a common cart-load—tied up in suitably sized fagots. These were handed through under the hoop, which was held down close to the ground, by assistants, and only raised when necessity required it. In the inside were other assistants, who took the straw and fired it through the furnace, the blaze striking out at the top, as represented in the plate. One of the inside assistants was provided with a sheet-iron paddle of sufficient size to cover the opening of the flue, which acted as a damper. This became occasionally necessary from the intensity of the fire and discharge of flakes and sparks. Several times these flakes did ignite the balloon in small points, but it was as often pulled down and the fire extinguished. The fire burned slowly and without a blaze, owing to the balloon being prepared with non-combustible glue-size. There was also in readiness a demijohn full of spirits of wine, with which to saturate the straw fagots at the close of the inflation, for the purpose of raising the rarefaction in the balloon to the highest degree at the time of starting, as Monsieur Vardalle carried no fire up with the machine to prolong his voyage with.

After the balloon was fully distended with heated air, the rope by which it was at first suspended was withdrawn, and the car was at the same time attached, on which the aëronaut mounted, when the huge machine was released, and it rose quickly but gracefully into the space above.

This ascension was made near sunset about the middle of October. The evening was calm and clear. The balloon ascended over half a mile—a height which it attained when about a mile off from where it started. It then commenced descending, coming down with a greatly accelerated velocity, and landed about two miles from where it started. When it struck the earth, it fell upon its side, which made it evident that the air which it contained could not have been much rarefied. In descending it would of course have a column of cold air rushing into it all the time, which would soon bring the air it contained to the temperature of the surrounding atmosphere, and the latter part of its descent would be regulated by the resistance of the air to falling bodies, which in so large a surface as presented in the machine just mentioned would soon stop its acceleration.

Although balloons of this kind bear no comparison to those of the hydrogen principle in aëronautic improvements, as a means of demonstrating aërostatic principles, they are very convenient and economical. Such a machine as the one just described can be inflated sufficiently to carry up a man, and the whole cost of such inflation would not exceed five dollars. But beyond such use they are not to be recommended, since in order to make long voyages with them fire must be carried along, which makes it very dangerous, unless some better mode shall be invented than that of carrying it in an open brazier.

True it is that we may discover a means by which caloric may be retained or confined in non-conducting vessels the same as we now retain hydrogen. Such a method once discovered, and a vessel invented for its use, we may easily conceive a further discovery by which caloric might be abstracted from the surrounding atmosphere as we travel through it and require it for use. Such a principle and its use as above described are as compatible with the laws of nature and progress of science as was the discovery of the water-pump and its application to common use by merely destroying the equilibrium of the atmosphere between the inside and outside of the pump. In the case of the balloon it only requires a destruction of equilibrium of the caloric inside and outside of it. Even the levity of hydrogen is owing to the superior affinity of the atoms of which it is composed for caloric over those of nitrogen and oxygen, which mainly constitute our common atmosphere. Indeed, chemical science is opening the door to the highway of aërial travel.

## VII.

Pilot balloons, how made—How coated with oil—How to inflate them—Gum-bag balloons—Devices—To soften gum-bags—To distend them—Small fire balloons, to make—Philosophical principles which govern their ascent—To make them ascend—Things can be sent up with them.

### PILOT BALLOONS.

The small balloons which are generally sent up at balloon ascensions to show the various directions of the upper currents of the atmosphere are called pilots. They may be sent up inflated with hydrogen gas or with rarefied air. The former kind are generally used as pilots, and the latter as toy balloons, made and sent up for mere amusement, with sometimes a piece of fireworks attached to them, which produces a very brilliant effect of a dark night. Those filled with hydrogen need not be more than eighteen or twenty inches in diameter to make them capable of ascending, and are constructed in the following manner: Take good close tissue-paper (the English is the best), and cut it into segments suited to the size of the balloon. These are then cemented together with a solution of gum-arabic. The segments should be cut so as to form a neck to the balloon when it is completed. In pasting them together the segments should first be folded once longitudinally, then by placing one on the other, so that its edge is a little behind the other one; the gum can be spread along the projecting edge of the lower one, when it can easily be folded up and over the edge of the upper one. Then another one is placed on the top of the upper and the same process gone through with, which is continued until all the segments intended for the balloon are put together, when the edges of the upper and lower segments are to be joined, which completes the machine in a regularly folded manner. Care must be taken while the joining is going on that the folds are not pasted together, which may be avoided by running the finger between them occasionally. When the balloon is done, its neck should be lined around its lower edge with a strip of muslin about a half an inch wide, to prevent it from tearing when it is placed over the tube from which it is to be inflated. Before these balloons can be inflated and sent up they must go through another process. Paper of any kind is too porous of itself to retain hydrogen gas. Therefore, just before they are to be used, they must be coated with common linseed oil, which can be spread on with a soft brush or tuft of raw cotton. This can be done very handily by laying one fold out after the other, so that when the pilot is oiled all over it is folded up again as it was when the oiling was commenced. The pilot unfolds itself as the gas is introduced. A pilot of two feet in diameter made in this way and inflated with hydrogen and its neck tied up will ascend up to and through the clouds; the porosity of the envelop will allow an escape of gas adequate to its expansion as it rises.

Devices of men, animals, fishes, etc., can be made in this way, and

sent up. A corpulent figure, representing the "Flying Dutchman," and sent up on occasions of balloon ascensions, has invariably produced a high degree of merriment.

Small hydrogen balloons of two or three feet diameter can be made by an expert hand from the common India rubber bottles which are kept at almost every drug store. These retain the gas for a long time. Some years ago one of this kind was made by Professor J. K. Mitchell, of Philadelphia, and sent up from there, which went some hundreds of miles before it descended, and then caused quite a consternation in the neighborhood where it came down, which, if my recollection serves me right, was at the head-waters of the Potomac River. They are made by the following process: the gum-bag is filled with ether and also placed in a vessel of ether so that all its surface is exposed to the solving liquid. When it gets soft, which may be in a day or two, according to the strength of the ether and the nature of the gum, and which must be looked to from time to time, the bag may be taken out and emptied of the ether and blown up. This is the most critical part of the process. Some parts may be more softened by the ether than others, and these will consequently expand faster than the others; therefore these parts must be protected, and the thicker and stubborn parts may be from time to time dipped into some ether. By placing the hands on the thin parts when blowing into the bag, these parts will be relieved and the stress exerted upon the rest of the surface. A few experiments by a skilful hand will enable him to make them nicely. Care should be taken to select the most perfect bags. The bag may be weighed, upon which it will be ascertained to what dimensions it must be expanded to to make it light enough to carry up what it is designed for when inflated with hydrogen. When it is sufficiently expanded, it should remain a while in that form, so as to give the membrane the right set.

## SMALL FIRE BALLOONS.

These are nothing more than rarefied air balloons, and get the appellation of "fire balloons" from their always being sent up with fire in them. Small ones of this kind are made of the same material and put together in the same manner as the hydrogen pilot, of which a description has already been given, only that the fire balloon need not be oiled. The same proportions as set down for the large rarefied air balloon may be observed in these small ones. They may also be made globular, but the most convenient shape is the egg shape—that is, like an egg with its pointed part cut off. They are generally made with long necks, which is wrong, and is the cause of their taking fire, and frequent failures in getting them off at all.

Fire balloons should never be made of less dimensions than three feet diameter. Though they can be made and elevated of even smaller size, still, it requires a good deal of care and nicety and delicate construction to make one of three feet diameter ascend handsomely. The experimentalist, if he be a novice in the undertaking, had better make his ma-

chine larger than three feet, and success will then be more easily attained. By making it still larger, say ten or twelve feet in diameter, he need no longer confine himself to tissue-paper, as he may use some heavier and cheaper, though tissue is the best. Some few years ago a lady made an ascension from Padua, in Italy, with a tissue-paper fire balloon covered over with a network. We may presume she carried no fire with it. The account of it stated that the balloon burst in coming down, but the lady came off with no other injury than a considerable jar.

In making small fire balloons we must not calculate on more than one-third of an ounce of ascending power for every cubic foot of capacity in the machine. Thus, if we look at the table of capacities and dimensions of balloons, we find one of three feet diameter to contain fourteen cubic feet. Hence one of this size with air highly rarefied would raise about five ounces, and hence, if the balloon and sponge containing the alcohol weigh more than five ounces, it will not rise—at least not by raising the temperature of air in it one hundred degrees above its surrounding atmosphere. Thus it will be seen that an experiment of this kind tried on a small scale requires to be conducted with a degree of nicety and skill which becomes less imperative as the magnitude of it is increased.

In the construction of a small fire balloon a light wooden hoop, or it may be of light wire, must be inserted in its mouth, so as to keep it apart. Two cross wires must be fastened on this hoop, and where they cross each other there may be a little wire cup or basket formed in which to place the cotton ball or sponge which contains the spirits of wine. A lump of cotton tied round and round with thread to keep more together answers very well, and I have generally preferred it to sponge. To send one up when of a small size, a quantity of alcohol, more than it is able to carry, may be placed in the wire basket, which will inflate it, and in the mean time grow lighter, so that by the time the machine is properly inflated and rarefied its fire burden will have become light enough to be carried up by it, and there will at the same time be remaining enough of fire matter to keep up the rarefaction after the balloon has started. Besides this, the burden continues to get lighter on its voyage as the matter in the basket consumes. In machines of a larger size a small furnace capped with a stove-pipe or other kind of tube may be used, by consuming paper or straw in it or anything that gives out little smoke and much heat, which will inflate it with more economy than alcohol, and the latter substance may be applied to the basket just before the machine is let up. Such as these may have parachutes attached to them with small animals, and regulated by a slow match to burn off the string which connects the parachute with the balloon.

## VIII.

General remarks on the art—Philosophy of varnish-coating to render stuff impervious to gas—Experiments on the diffusion of hydrogen in balloon—Escape of experimental balloon—Double envelope, prepared well, would retain gas long enough to go round the world with—Aërial voyages are life conservative—Their philosophy considered—Their effects as experienced.

Having detailed the manner of constructing and managing balloons on the most improved methods, some general remarks will properly conclude this part of the work.

Gold-beaters' skin has been highly recommended by some persons as making a very impervious envelope for gas. I have tried this, and found it even inferior to varnished silk or muslin. It seems that all animal membranes are porous, and naturally adapted to the passage of gases and liquids. The membrane of lungs lets the oxygen of the atmosphere pass through, while it obstructs the atoms of nitrogen with which the oxygen is diluted. Animal membranes have a peculiar texture adapted to the transmission of some liquids and gases, and not to others. And there appears to be a peculiarity of shape, size or roughness to each gas, to which the porosity of any substance must be adaptable in order to let it pass through. The very best method that I have yet discovered to effect this is to coat the material intended to retain the gas with linseed oil varnish in very thin layers. If put on thick in one coating, it seems to get porous in drying, and so will a thin coat, but by repeated layers each succeeding one will cover over the pores of its antecedent.

This nature of porosity applies also to membranes of gum-elastic; and when this substance is to be used for gas envelopes, it makes a more impervious coating by being laid on in repeated layers than when put on in one heavy coat. The affinity which gases have for each other is remarkably strong, and in some cases it will pervade any substance that may intervene.

I made an experiment with a silk balloon which held thirty cubic feet, coated like the balloons commonly used by me for ascensions. This was filled with hydrogen evolved from water by sulphuric acid and iron turnings, and fastened to a weight in the cellar, there being a circulation of air through the cellar, as in common cases. The first, second and third days the balloon gradually diminished its bulk, and its greatest diminution was about one-tenth, and it also lost about one-tenth of its ascending power. The fourth day it seemed to be increasing its bulk, and the fifth it was very perceptible. On the sixth it was nearly as full as it was when first put down, and on the seventh it showed that it would burst if suffered to go on increasing in bulk in the same ratio a day longer, upon which I relieved it by opening its neck, which had been well tied up, and then it soon lost its ascending power. Before I opened

the neck I tried its ascending force, and found it had not lost as much the last three days as it had the first three.

This same balloon was taken and recoated three times more, but the whole of these coatings did not increase its weight quite half as much as the whole weight of its former coating amounted to. Upon being filled again with hydrogen, it did not lose as much on the first ten days as it had on the former occasion in thirty-six hours. After this it was used for several days in electrical experiments, during which it got off with several hundred yards of twine, and I never heard of it afterward. It must soon after its release have got vent sufficient to allow an escape of gas by expansion, but may have reached the Atlantic before it came down, as the last course it was seen sailing was due east, and it had but one hundred and thirty miles to go in that direction to get to sea.

To make a balloon that would retain its hydrogen for months or a greater length of time out of cloth material, it only requires the substance to be coated—silk or muslin it may be—in thin layers; and from experiments I find that two layers of silk or muslin, coated in this way and laid together so as to make a double envelope, increase its imperviousness in a remarkable degree.

### AËRIAL VOYAGES ARE LIFE CONSERVATIVE.

If aërial navigation, or ballooning as it is, had not a strong claim on our inventive energies, from the auspicious developments that are now so rapidly succeeding each other in the arts and sciences, it would of itself in its present simplicity command a desire to seek its use as we seek life itself, were it only generally and properly comprehended in its health-promoting, life-saving and soul-and-body-invigorating capabilities. Human beings will seek distant climes under all the tortures and enervating vicissitudes of long and perilous sea-voyages for the purpose of relieving their constitutions from the devouring effects of chronic diseases, but many of them only attain their graves in the silent deep while in search of the goal of health. The elysian fields of health are much easier to be found by the use of balloons. Milton says,

> "The river of life, through midst of heaven,
> Rolls o'er elysian flowers her amber stream."

And if Milton had never expressed the idea in his heaven-born poetry, the laws of life and the philosophy of its circumstances would be amply sufficient to sustain what shall be written on this point. With such auxiliaries, in connection with the progressive spirit of the age, the doctrine about being set forth will not be considered vainglorious, but real glorious in the cause of the alleviation of the human family from the pains and evils that flesh is heir to.

That atmospheric pressure has a great deal to do, if not all to do, with the mechanical functions of life must be admitted by all sound reasoning on the subject; and if reasoning alone will not answer, the

*experimentum crucis* is demonstrable by sending chronically diseased persons through the healthy fields of life-inspiring air above the earth and examining the results. From such arguments have proceeded my conclusions. When I first engaged in the business of aëronautics, I was suffering from chronic dyspepsia, added to a severe affection of the lungs, caused by a long-continued inhalation of dust composed of rose wood and the fine particles of glass arising from the use of glass paper upon such wood, which my business (piano-forte making) then subjected me to.

From the devouring ravages of such a complicated disease the practice of ballooning relieved me, notwithstanding the perplexities attending the first six or seven years while engaged in it were of themselves more than sufficient to countervail any ordinary life-conserving operations.

That atmospheric pressure has a powerful influence on the lungs was known long ago. Doctor Arbuthnot, a celebrated English physician and writer, says of it: "The pressure of the air upon the lungs is much less than it has been computed by some, but still it is something, and the alteration of one-tenth of its force upon the lungs must produce some difference in elutriating the blood as it passes through the lungs."

This *elutriation* is the very fulcrum of the life principle. Upon this it rises or falls, grows weaker or stronger, languishes or fires up. In the lungs the life principle is generated; they form the medium through which the electricity of life is abstracted from the oxygenated atmosphere, where it is thrown back by their action as asphyxiated death vapor. It is there that motive-power is acquired and applied through the blood to the heart (the working cylinder and balance-wheel of the animal system), which returns, like the exhausted steam of a low-pressure engine, to be again calorified or electrified, only to repeat its offices over and over again. This, although perhaps not exactly to be found written in books of animal physiology as here stated, is nevertheless borne out by the present known science of animal life, and identifies the old doctrine of blood oxygenation with the present of blood electrization.

The atmosphere exerts a pressure of from twenty-five to thirty thousand pounds upon the human body of full growth; and if, as Doctor Arbuthnot says, the alteration of one-tenth of this force produces a great difference in the elutriation of the blood in the lungs, such change is acquired at a very moderate height in the atmosphere, and one-fourth, and even one-half, the difference of the whole pressure can easily be acquired by the use of balloons. By elutriation he means the changing of the blood from its black to its bright red color. But I hear a scientific voice say we can acquire this change of pressure pro and con by the air-pump and condensing machine. So we can, but under very different circumstances from those under which we acquire it in the pure upper regions of the atmosphere. In the exhausted receiver the air would soon become asphyxiated, and every new inhalation would be followed by a discharge of death vapor, to say nothing of the monotony of such

a remedy. This is not the case in the upper regions of the atmosphere; there the advantages come even in a stronger ratio than the disadvantages do in the other case.

Let us consider them. All diseases indicate a want of life—electrical stimulus. I know doctors say, sometimes, men die of too much health. In such cases of disease they might be put under the air-condensed process, if the truth of such a cause of disease and death could be unequivocally established. At all events, if there be such a disease, the human family has never yet suffered much from its ravages. However, if it be so, the reverse of the case ought to hold out, that we might get too sick to die, which seems to be neither philosophical nor logical.

Now, as we rise up in the atmosphere, there are two causes acting in beautiful harmony upon the invalid calculated to produce the most happy results. While the most sublime grandeur is gradually opening to the eye and the mind of the invalid, the atmospheric pressure is also gradually diminishing upon the muscular system, allowing it to expand, the lungs becoming more voluminous, taking in larger portions of air at each inhalation, and these portions containing larger quantities of caloric or electricity than those taken in on the earth, and the invalid feels at once the new life pervading his system, physically and mentally. The blood begins to course more freely when up a mile or two with a balloon, the excretory vessels are more freely opened, the gastric juice pours into the stomach more rapidly, the liver, kidneys and heart work under expanded action in a highly calorified atmosphere, the brain receives and gives more exalted inspirations, the whole animal and mental system becomes intensely quickened, and more of the chronic morbid matter is exhaled and thrown off in an hour or two while two miles up on a fine summer's day than the invalid can get rid of in a voyage from New York to Madeira by sea.

The appetite is extraordinarily affected in a balloon ascension. This feature of the effects of aërial voyages never diminished in the least with me during fifteen years. It always gave me a ravenous appetite for animal food.

The pneumatic effects, as above stated, will not be questioned by any person acquainted with the nature of the atmosphere, and the consequent results upon the human system as described are as natural to them as it is for night to follow day.

It would seem as though nature itself cried aloud to us upon this subject, inviting us to its elysian fields to drink in the fluid of life and relieve poor enervated humanity.

THE END